A COMPARISON STUDY OF SUMMER-SEASON LAND SURFACE CLIMATOLOGY IN CFSV2 WITH THREE CFS RUNS USING DIFFERENT ATMOSPHERE AND OCEAN MODELS

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CFSv2 Evaluation Workshop

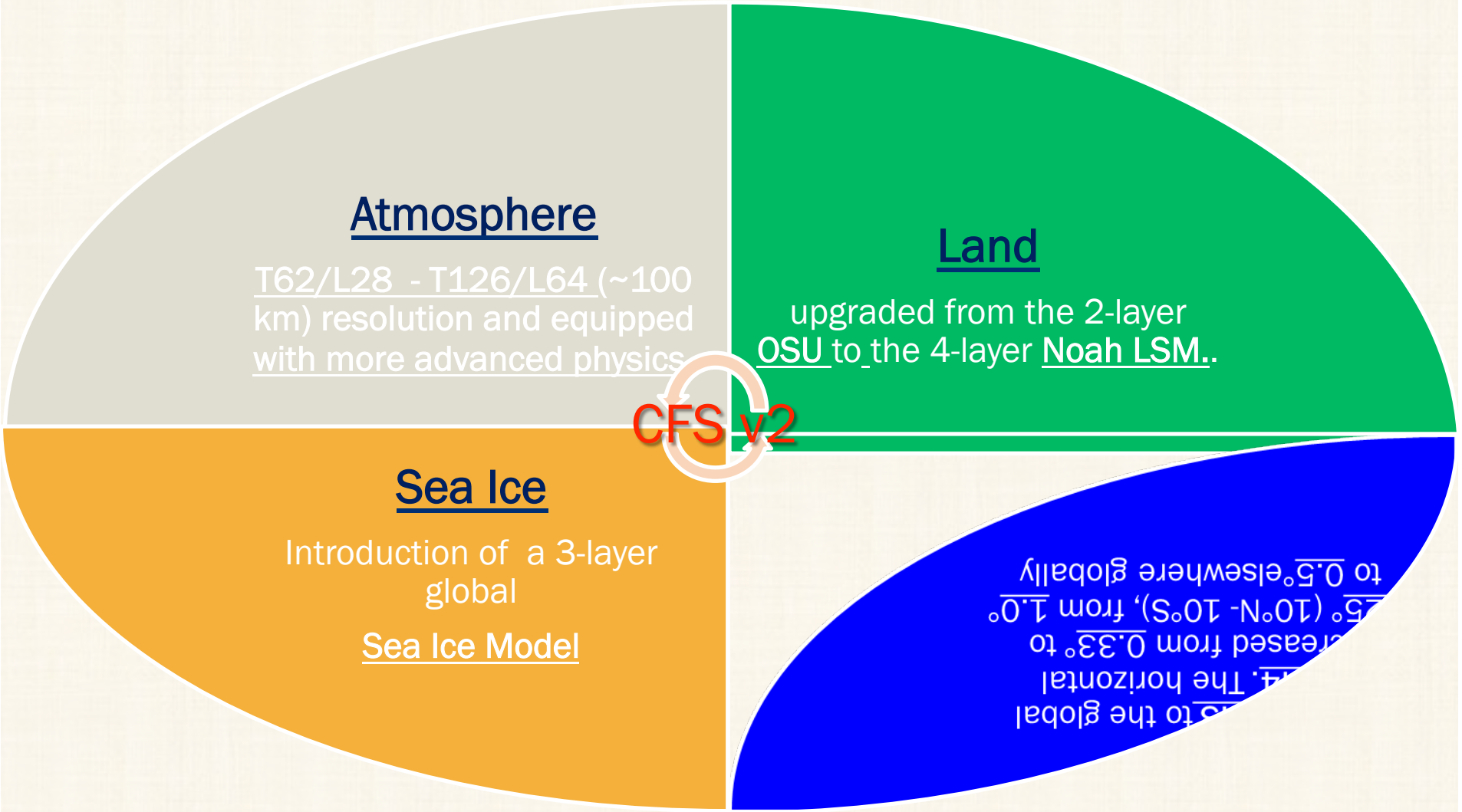
April 30 – May 1, 2012

College Park, Maryland

OBJECTIVES

- Compare the differences in predicted warm season surface characteristics between the CFS runs.
- Examine the impact of upgrades on ocean, land and atmosphere and their relative importance on predicted climatology and prediction skills.

THE NEW NCEP CFS V2



Fully Coupled Ocean-Land-Atmosphere System, implemented in March, 2011

CFS COMPARISON

1982–2004 (23 **summers**)

CFSv2	Op3t3 CFS	Op3t3 CFS	CFSv1
CMIP	AMIP	CMIP	CMIP
ICs (12)	ICs (10)	ICs (10)	ICs (10)
T126/L64	T126/L64	T126/L64	T62/L28
0421, 0426, 0501 (4 cycles)	041900 -042300 042900-050300	041900-042300 042900-050300	041900 -042300 042900-050300

The Op3t3 CFS shares the same ocean model used in the CFSv1

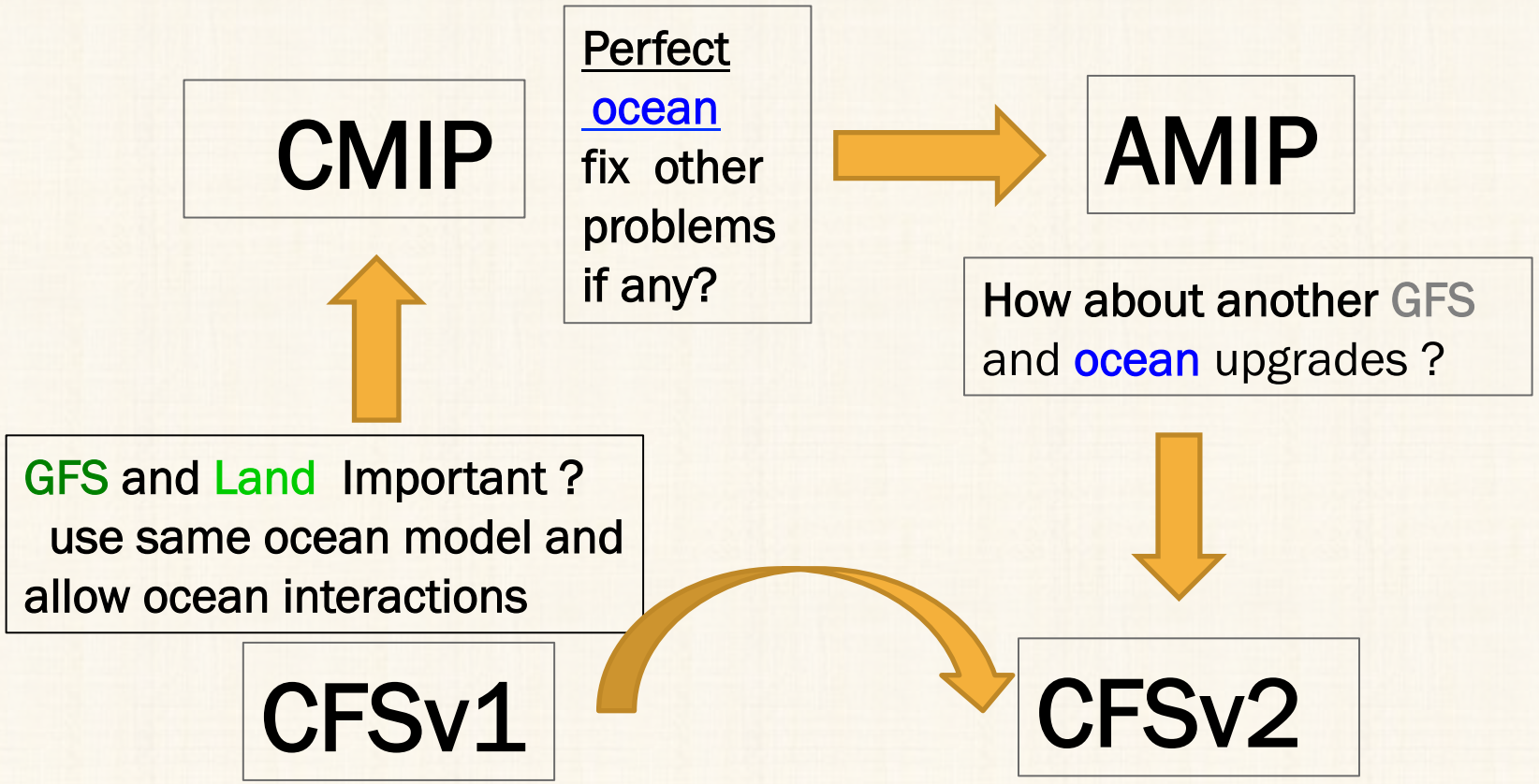
The CFSv2 shares the same Noah land model used in Op3t3 CFS

Self consistent initial conditions (Mid-April to Early May)

CFSv2 --- from CFSR; Op3t3 CFS – from offline GLDAS ; CFSv1 – GR2

Focus on June, July and August Average (JJA)

WHAT WE CAN LEARN?

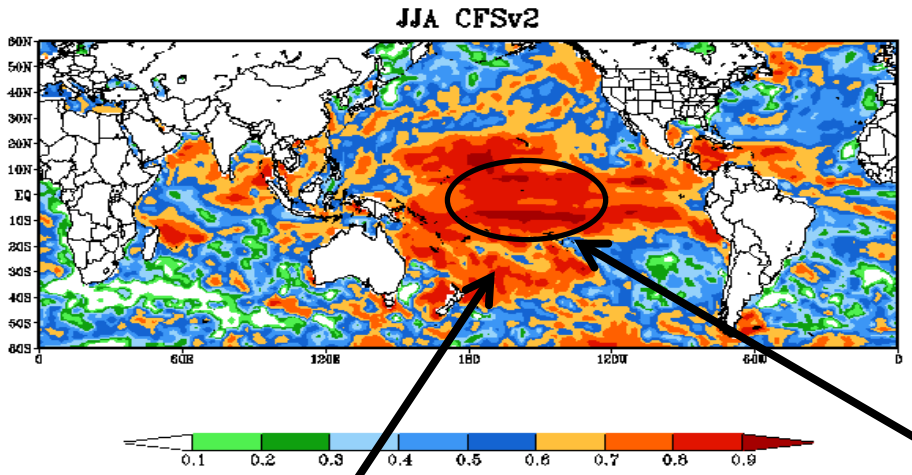


- Identify the relative importance of each component from a variety of upgrades and potential problems.
- Determine the direction for future improvement.

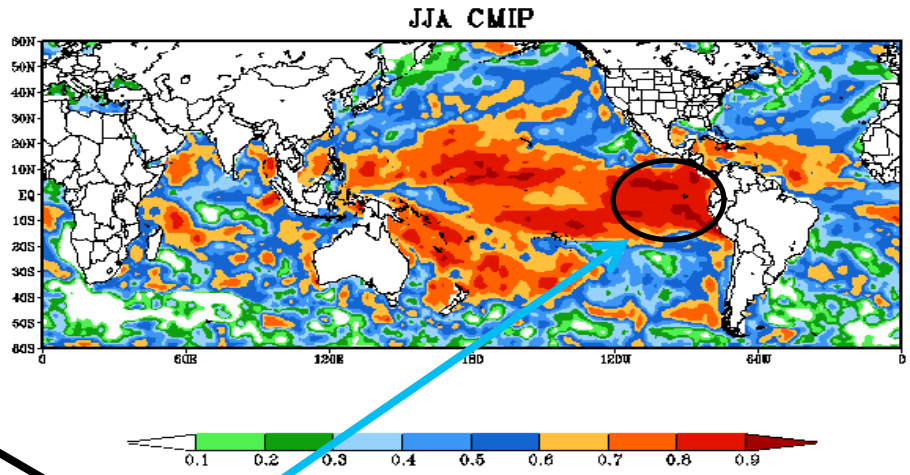
SST, PRECIPITATION, AND T2M COMPARED TO OBSERVATIONS

SST SKILL

CFSv2

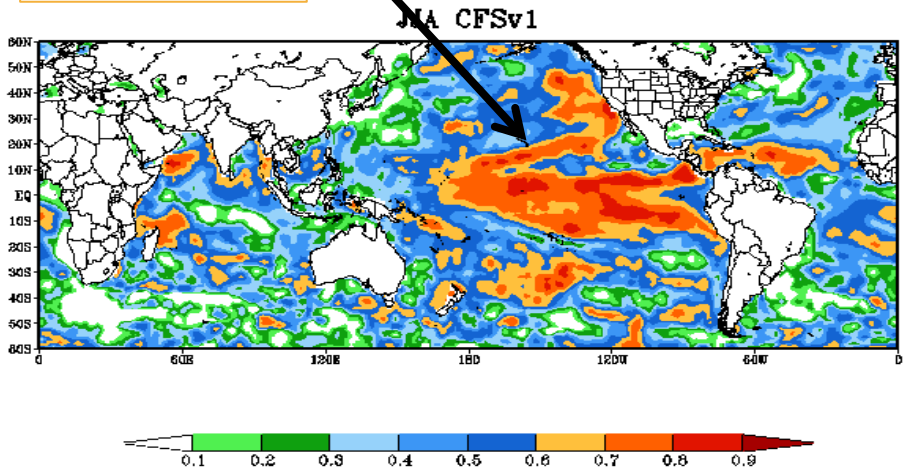


CMIP



Much Better Than CFSv1

CFSv1



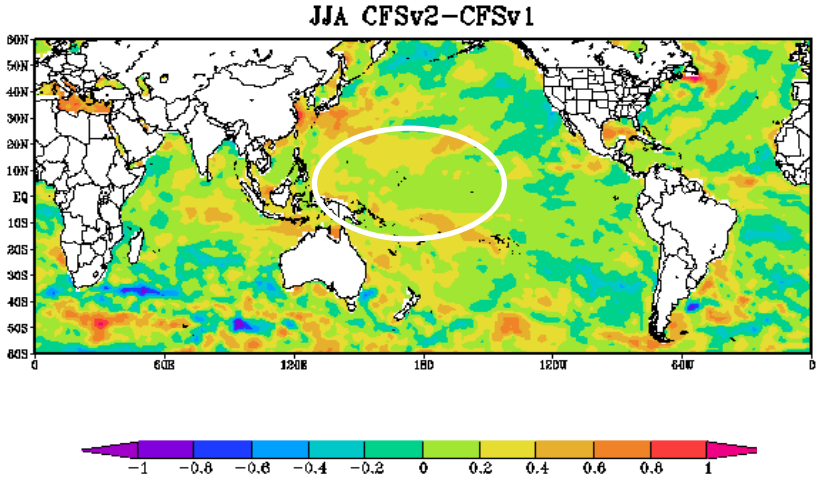
Mixed, depending on the Nino regions

Both CFSv1 and CMIP use MOM3

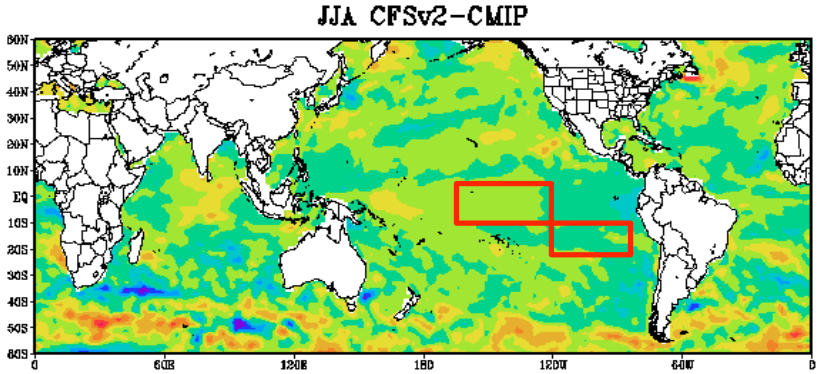
CMIP has the atmosphere and land upgrades. The skill is comparable to CFSv2

SST SKILL DIFFERENCE

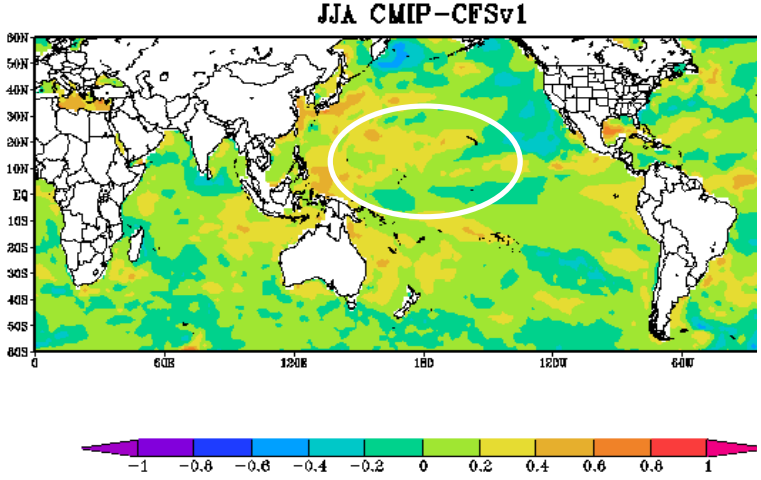
CFSv2 –CFSv1



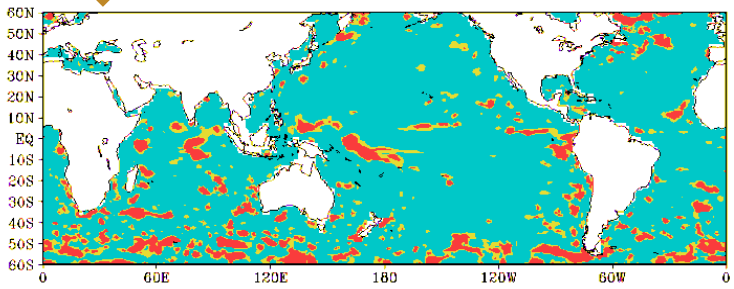
CFSv2 –CMIP



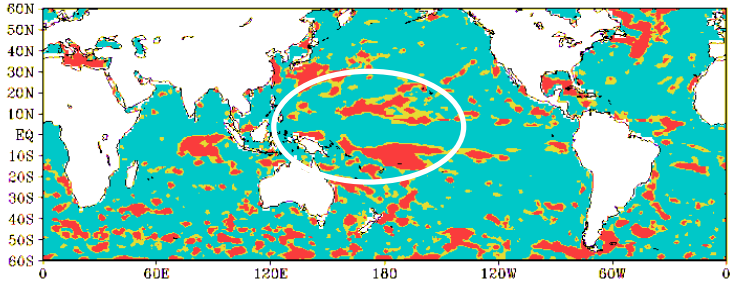
CMIP–CFSv1

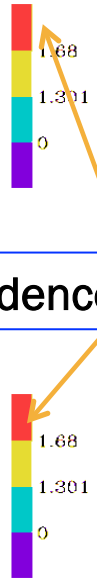


CFSv2 vs CMIP



CFSv2 vs CFSv1



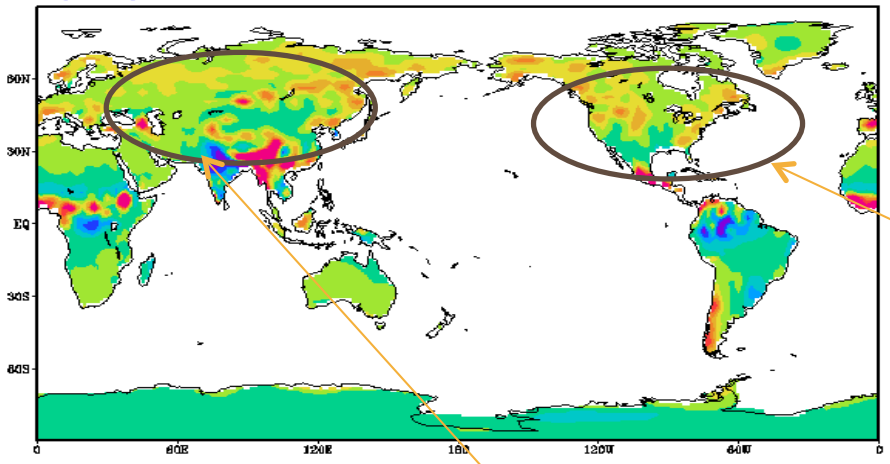


95% confidence

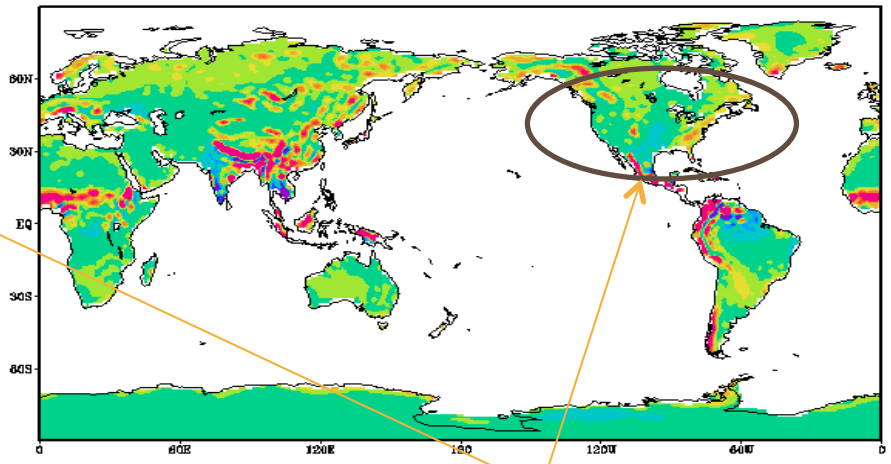
Significance Test

PRECIPITATION - OBSERVATION

CFSv1



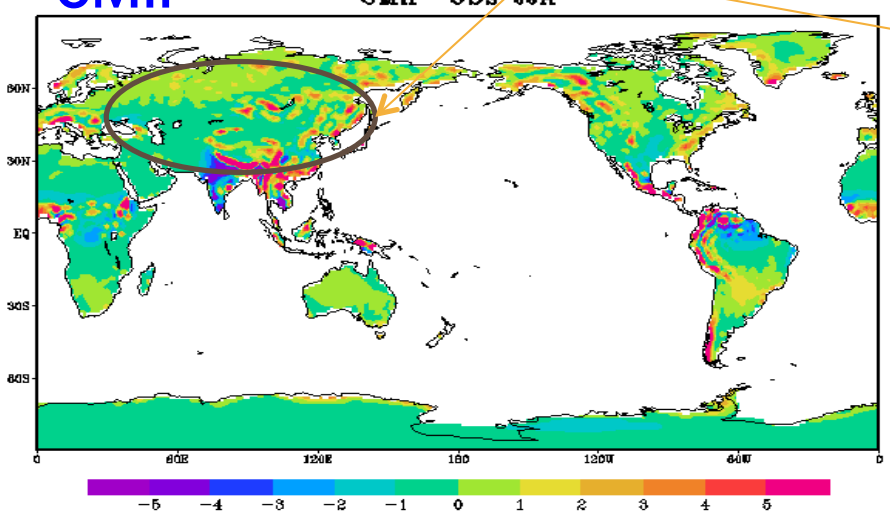
AMIP



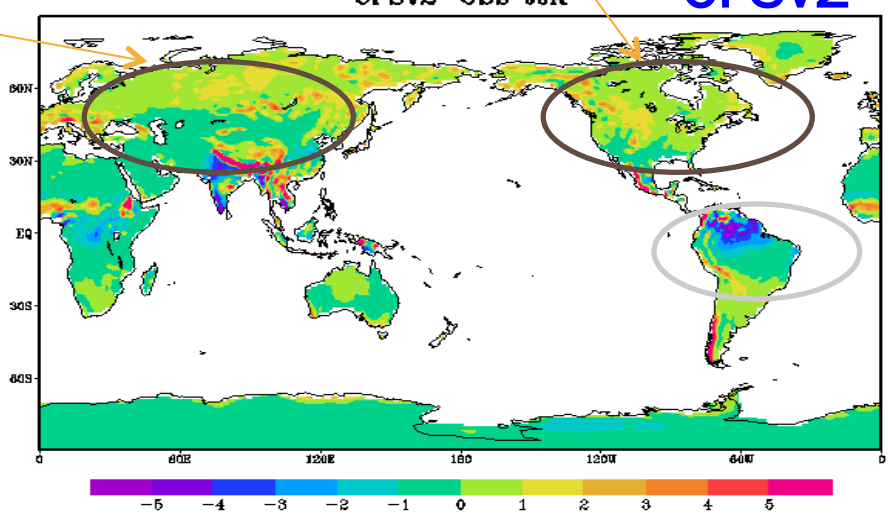
Reduce high bias over N.H. with land and GFS

CMIP and AMIP seem better over N.A..

CMIP

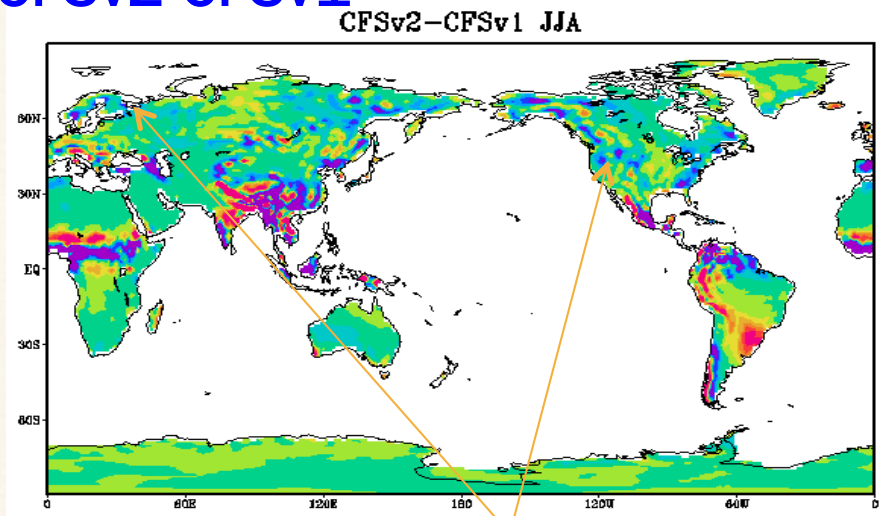


CFSv2

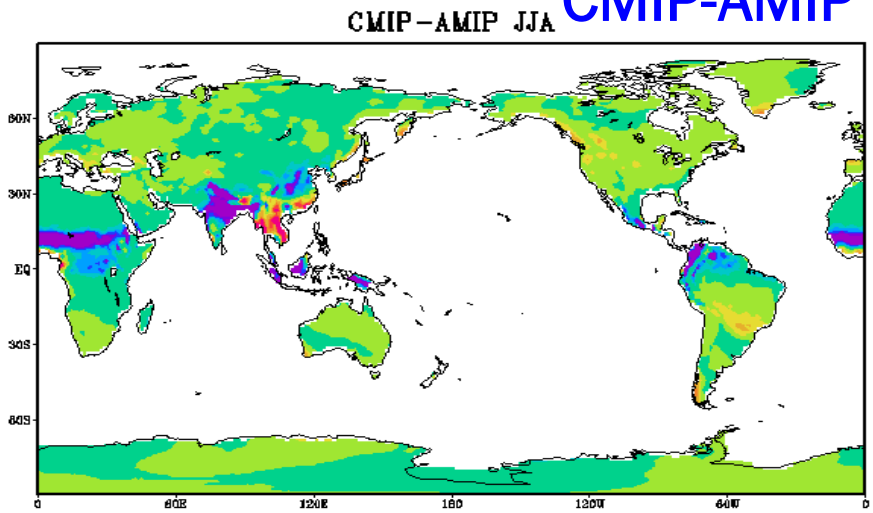


PRECIPITATION DIFFERENCE

CFSv2-CFSv1



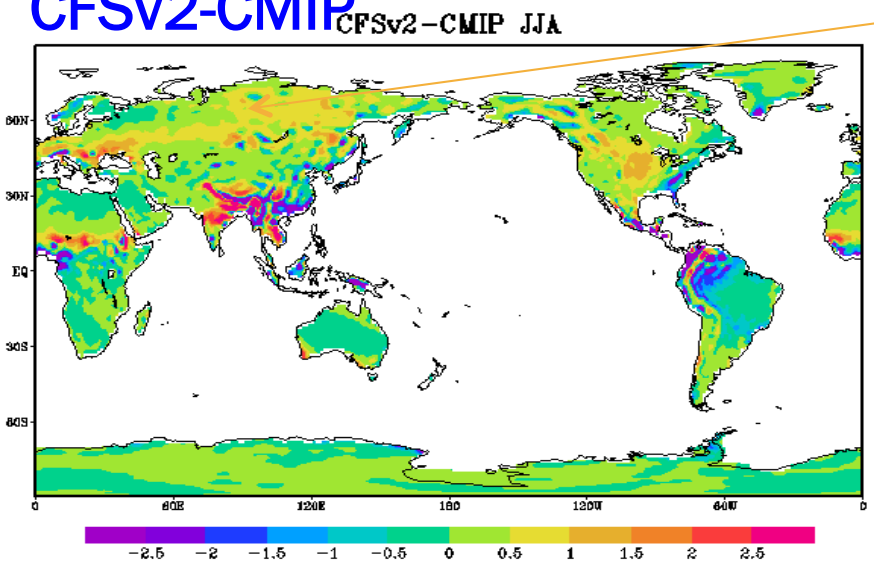
CMIP-AMIP



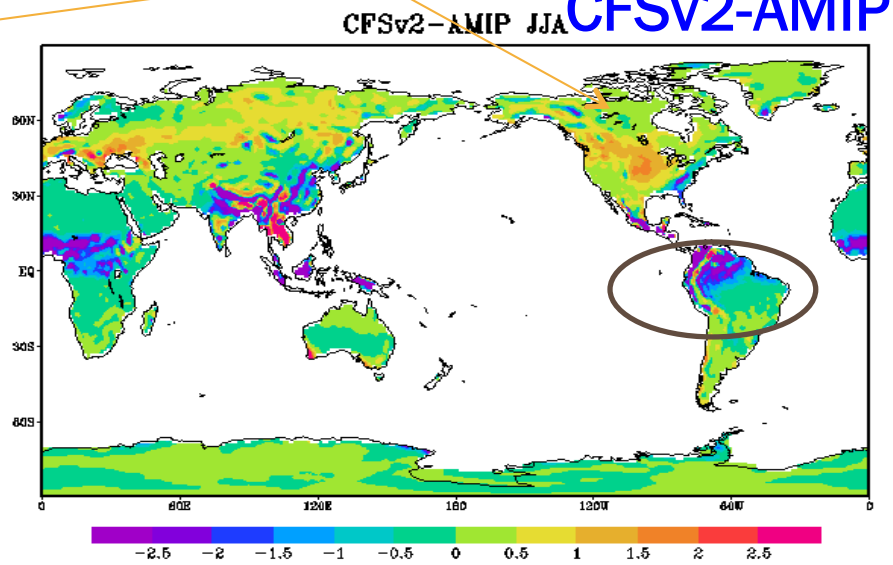
CFSv2 lower than CFSv1

CFSv2 higher than CMIP and AMIP

CFSv2-CMIP

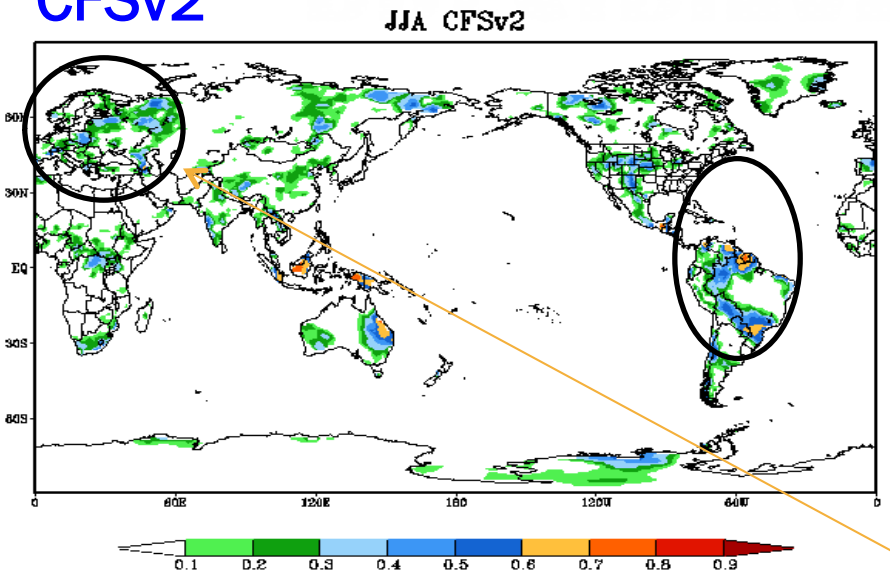


CFSv2-AMIP

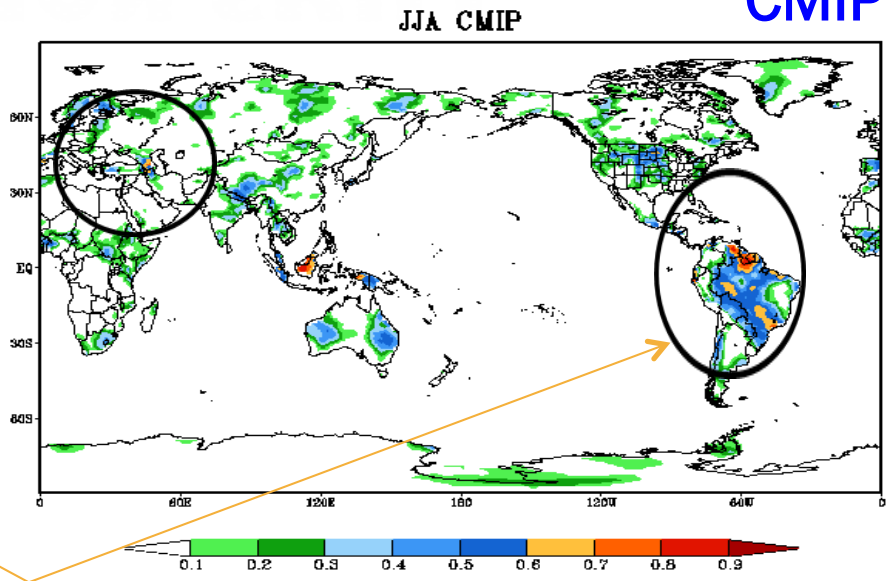


PRECIPITATION SKILL

CFSv2

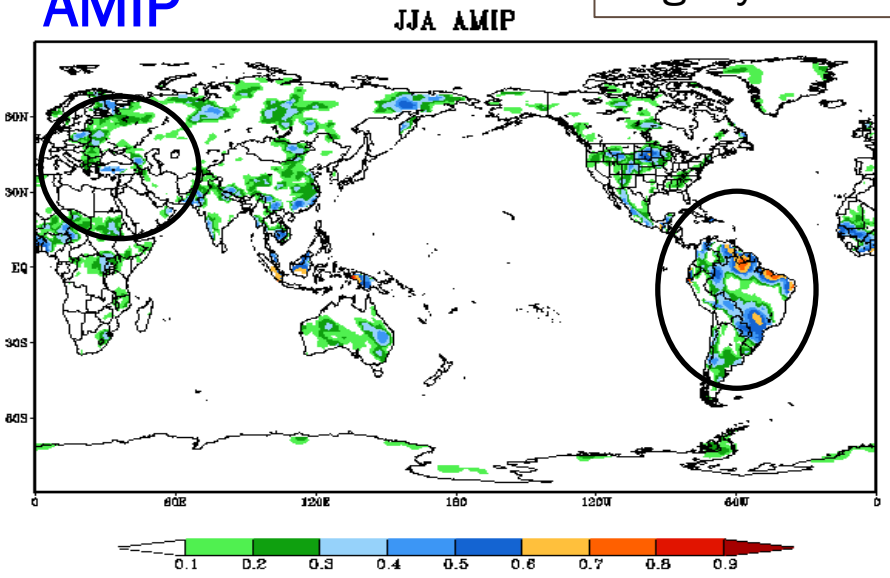


CMIP

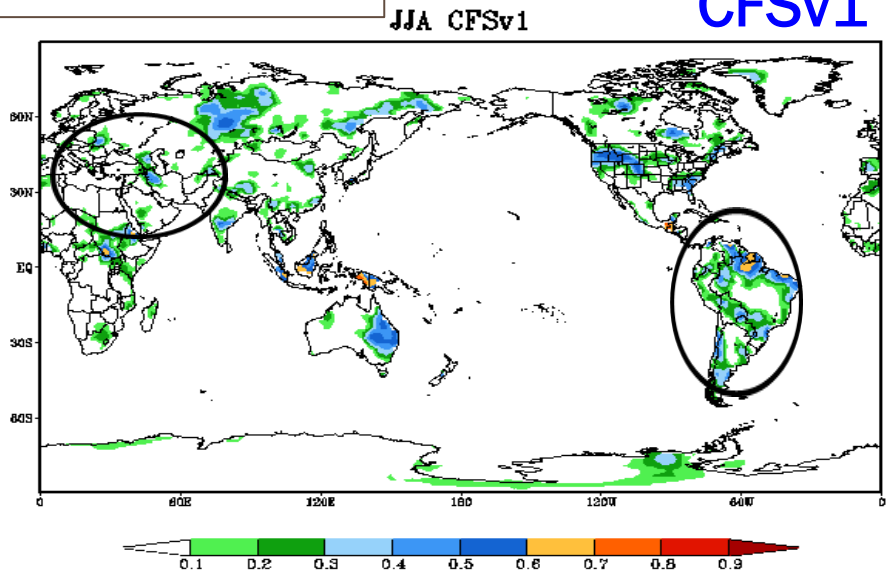


Slightly better in CFSv2 and CMIP

AMIP

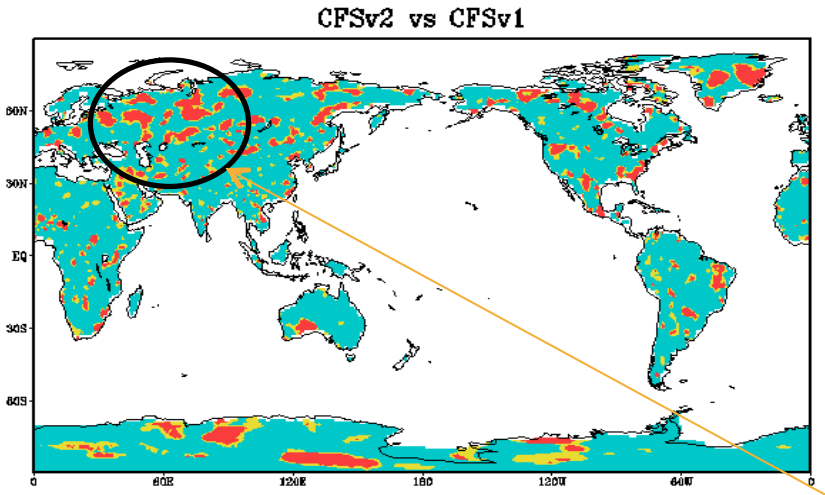


CFSv1

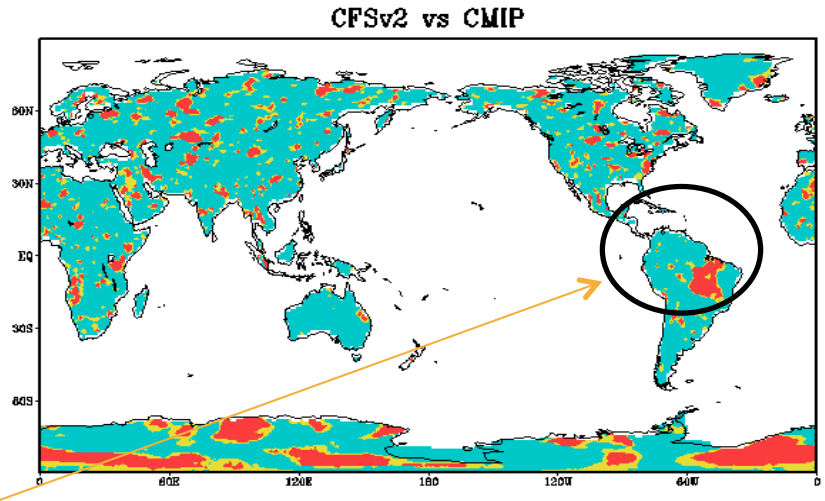


PRECIPITATION SIGNIFICANCE

CFSv2 vs CFSv1

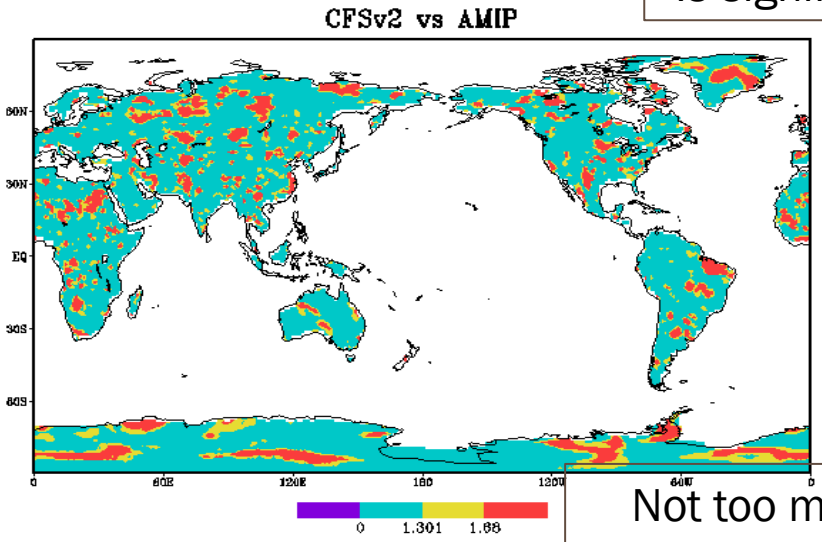


CFSv2 vs CMIP

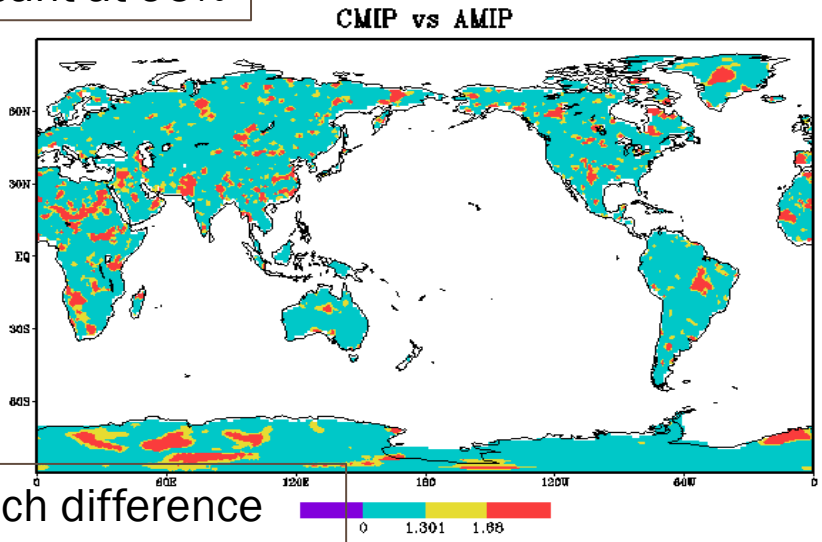


The differences
Is significant at 95%

CFSv2 vs AMIP



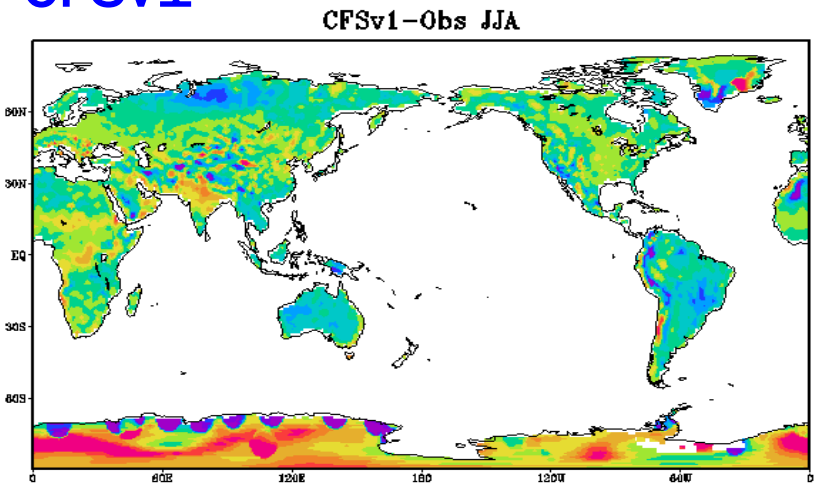
CMIP vs AMIP



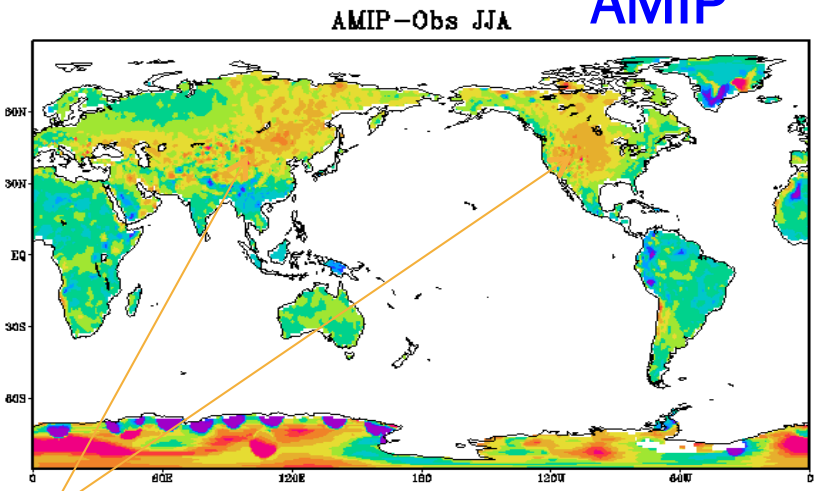
Not too much difference
between CMIP and AMIP

T2M - OBSERVATION

CFSv1

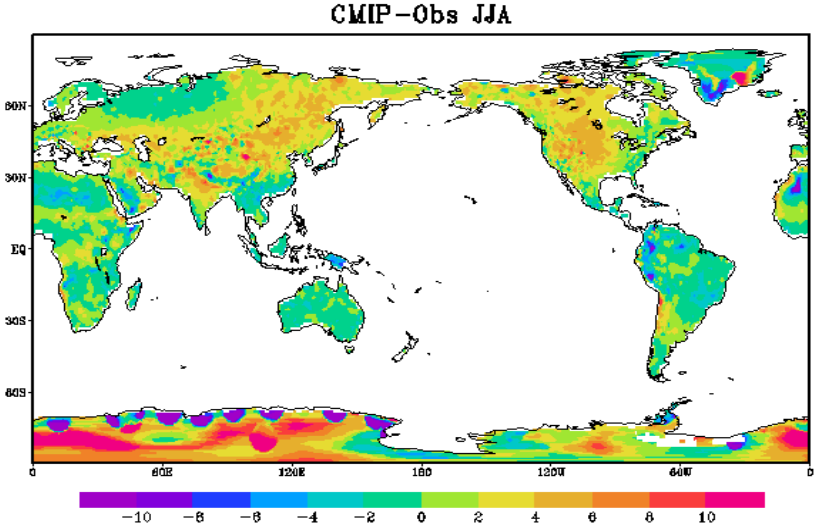


AMIP

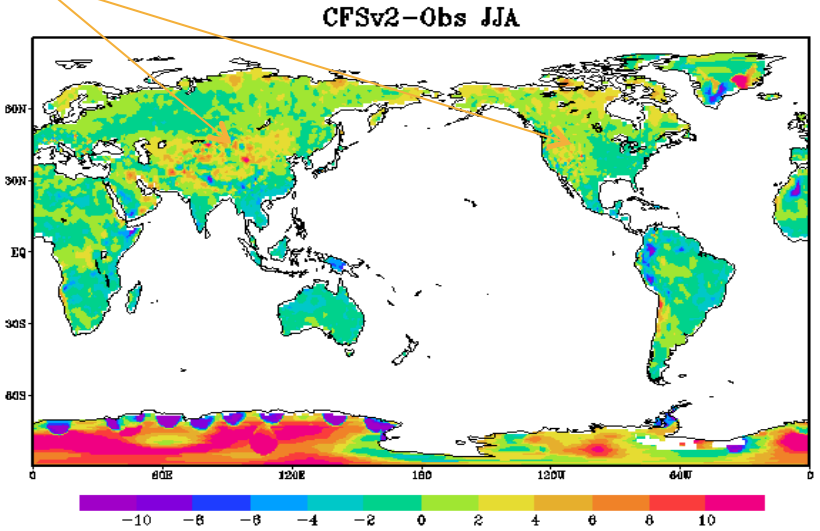


Consistent with precipitation bias over the N.H.

CMIP



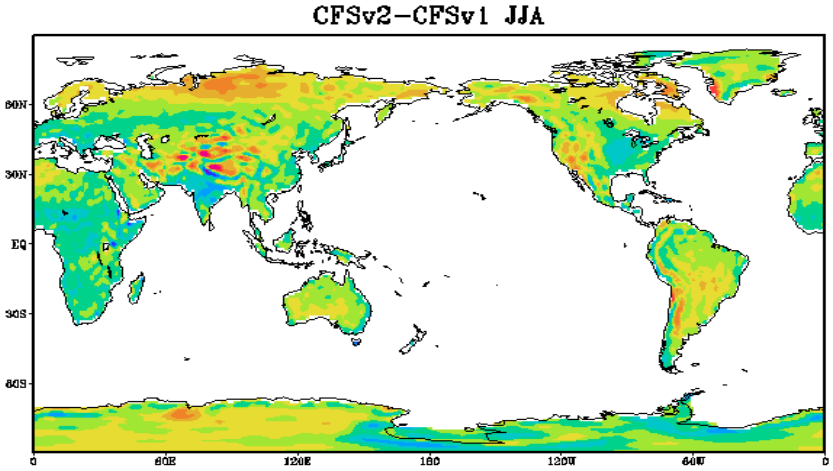
CFSv2



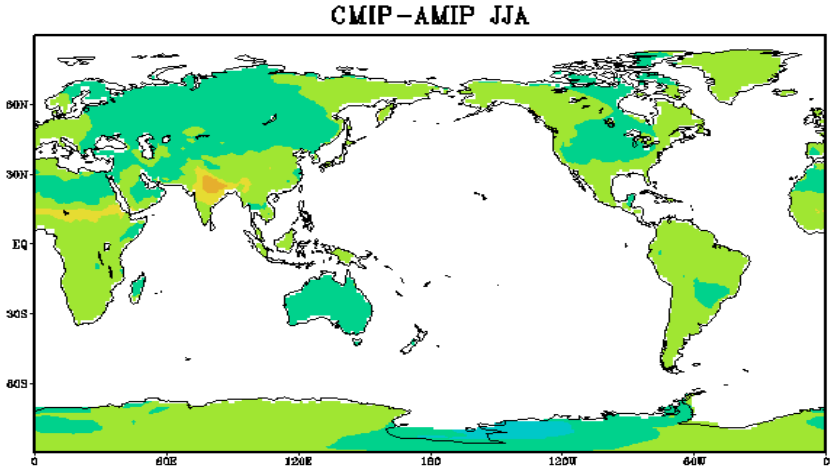
T2M DIFFERENCE

CFSv2-CFSv1

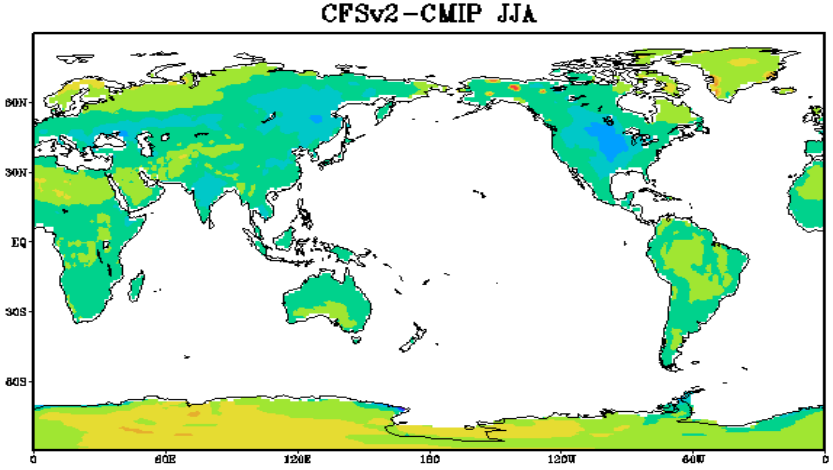
CFSv2 is warmer than CFSv1



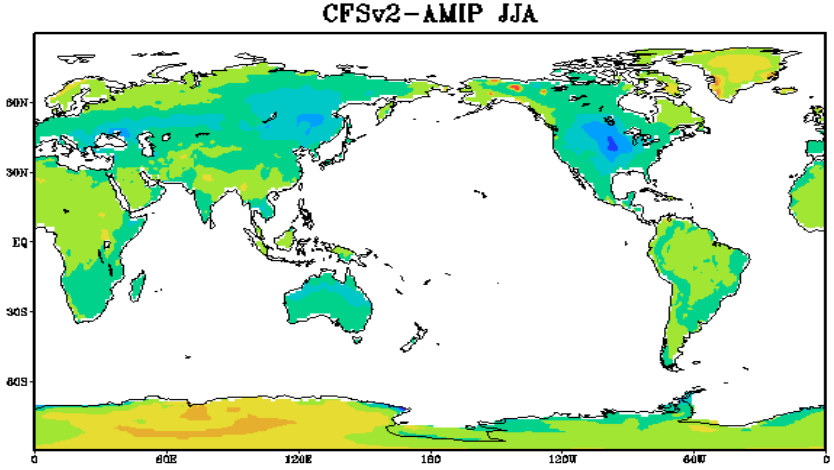
CMIP-AMIP



CFSv2-CMIP



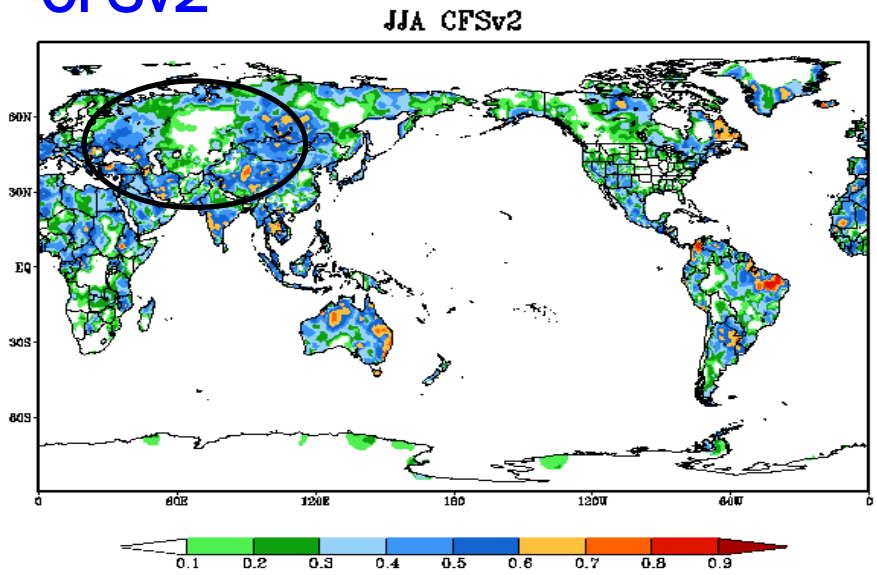
CFSv2-AMIP



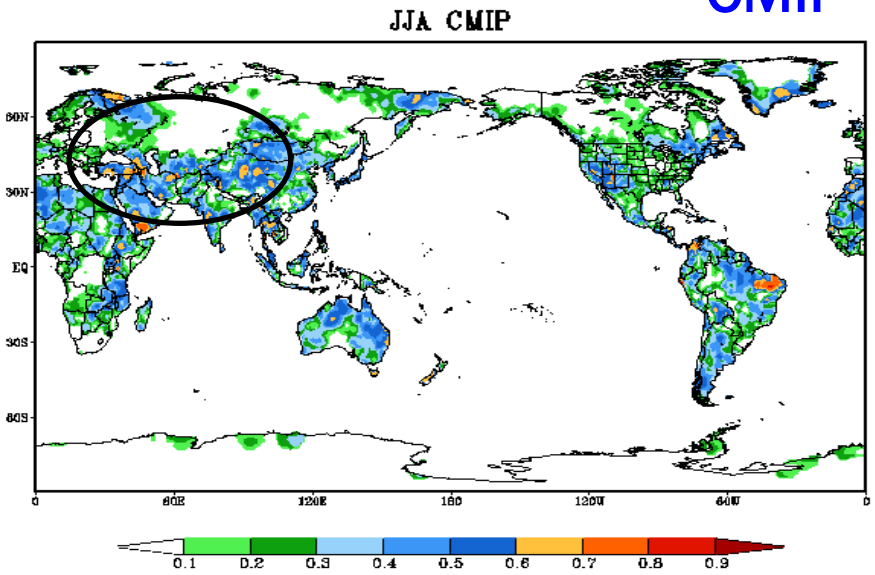
CFSv2 is colder than CMIP and AMIP

T2M SKILL

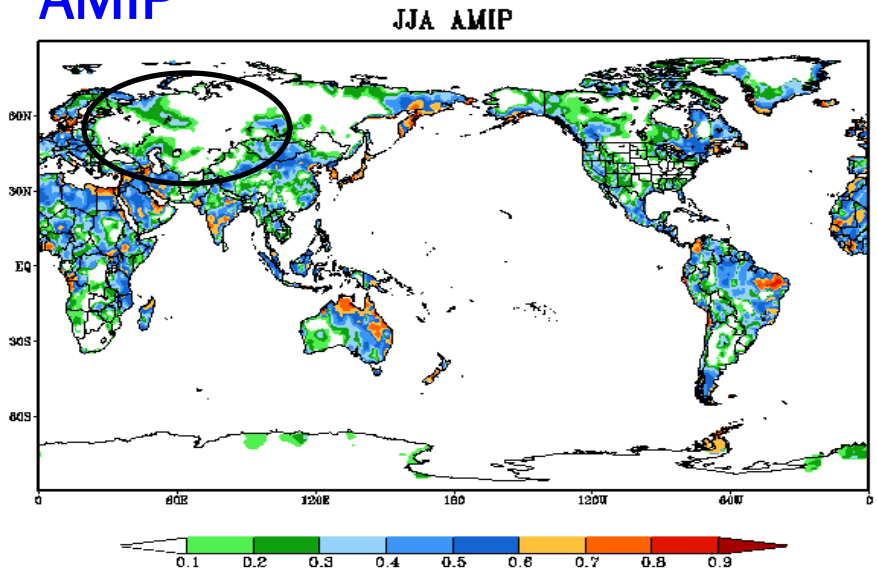
CFSv2



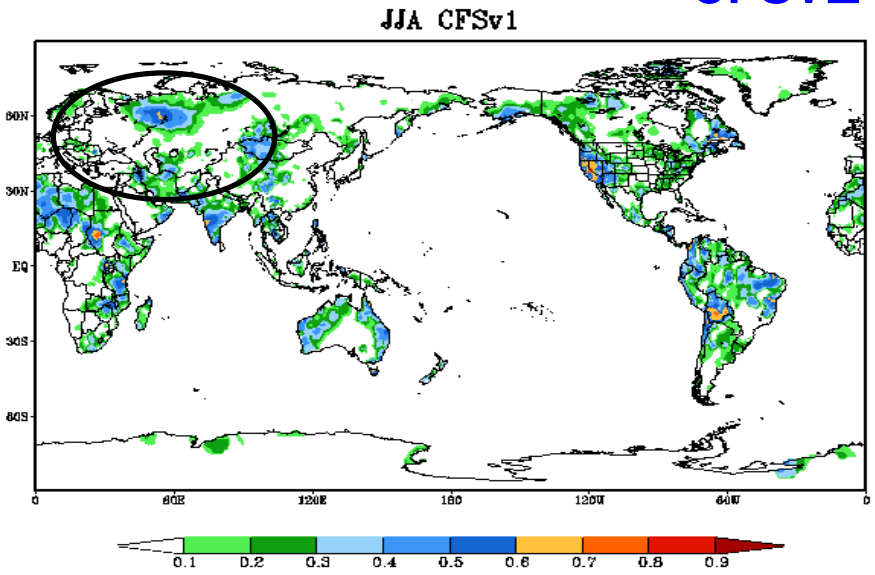
CMIP



AMIP

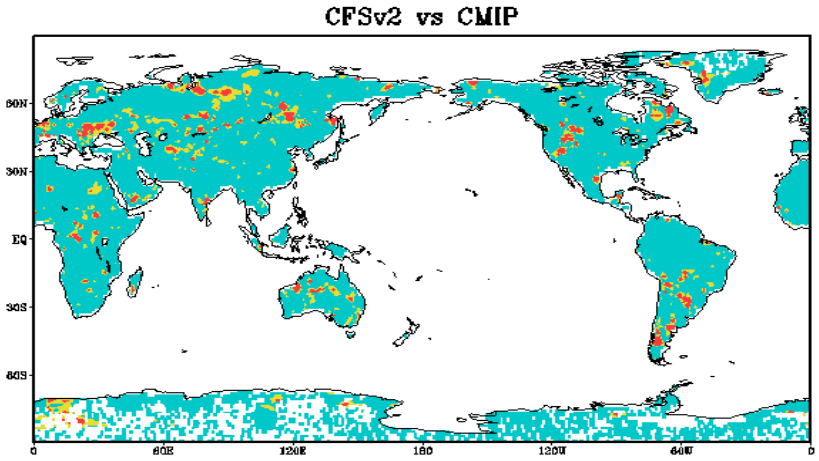


CFSv1

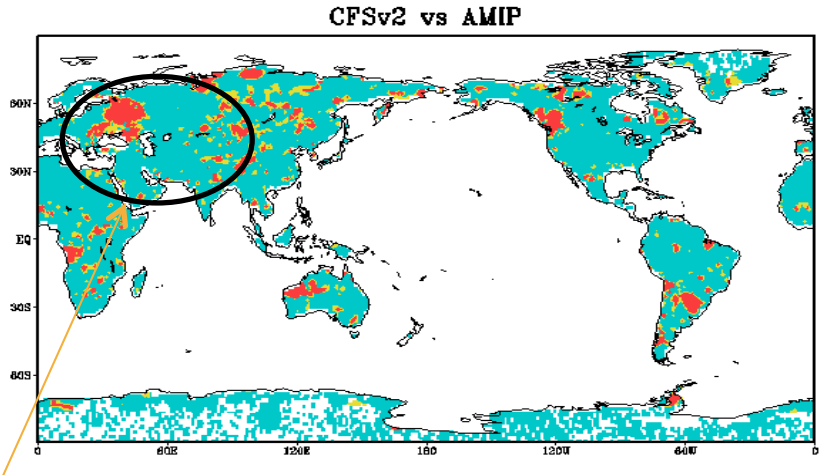


T2M SKILL SIGNIFICANCE

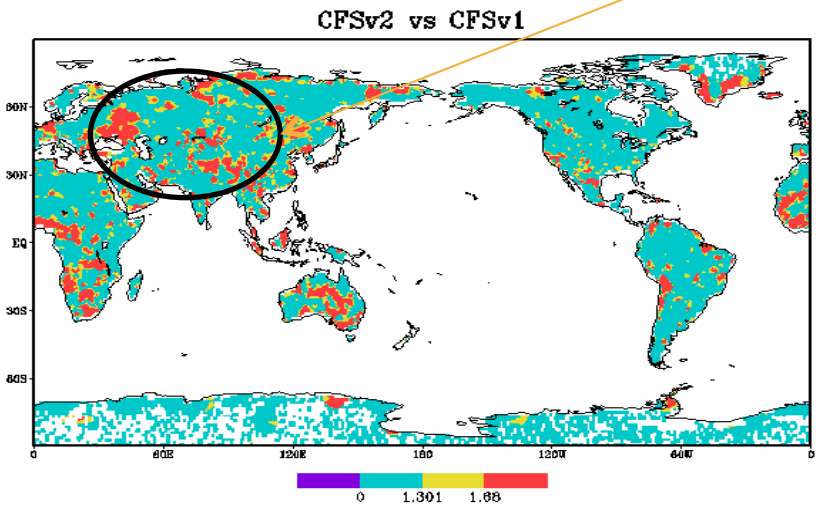
CFSv2 vs CMIP



CFSv2 vs AMIP

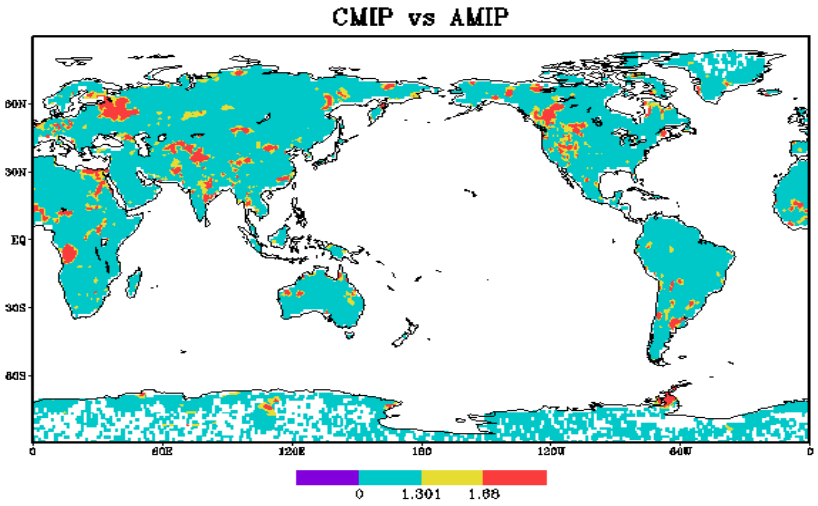


CFSv2 vs CFSv1



better

CMIP vs AMIP



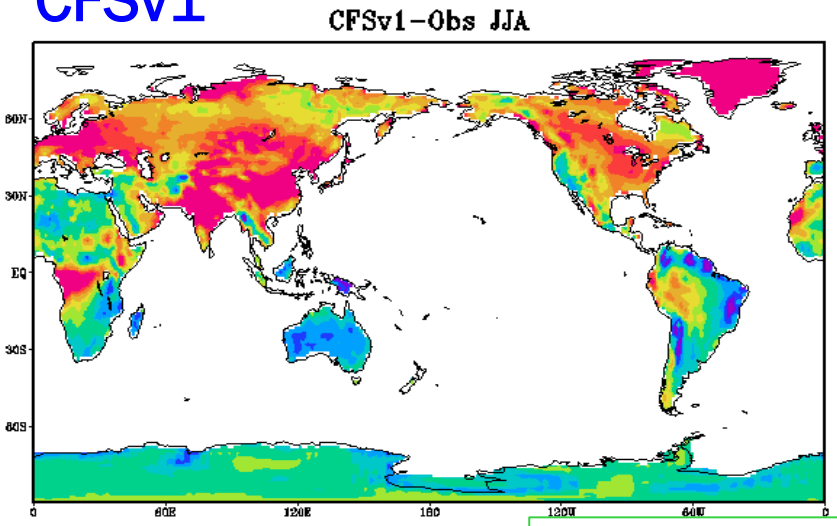
DOWNWARD RADIATION (RDOWN) AND NET RADIATION (RNET) COMPARED TO

The NASA/GEWEX *Surface Radiation Budget* (*SRB*) Release-3.0 data

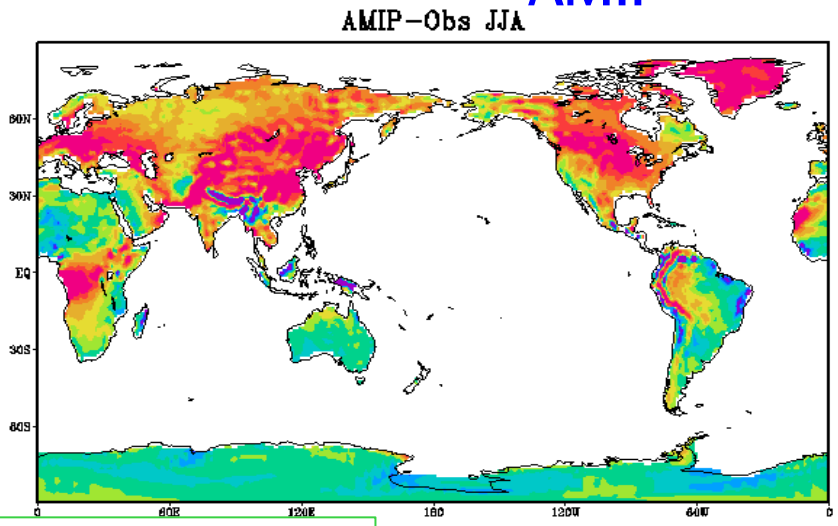
As a reference

RDOWN – SRB

CFSv1

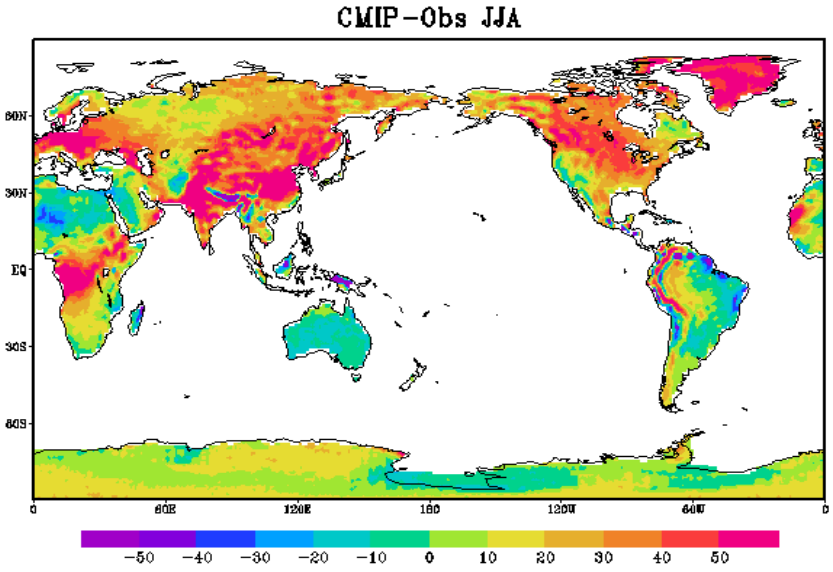


AMIP

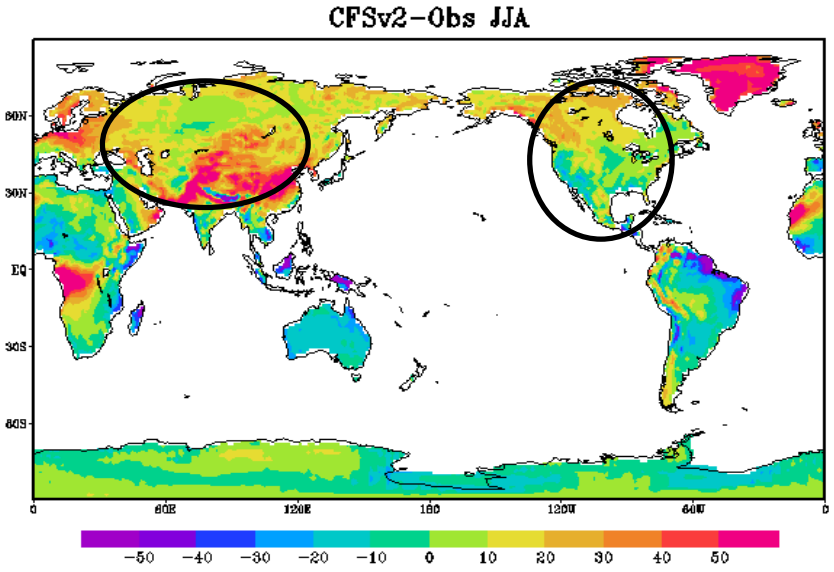


CFSv2 lower than the other 3
Closer to the satellite retrieval

CMIP

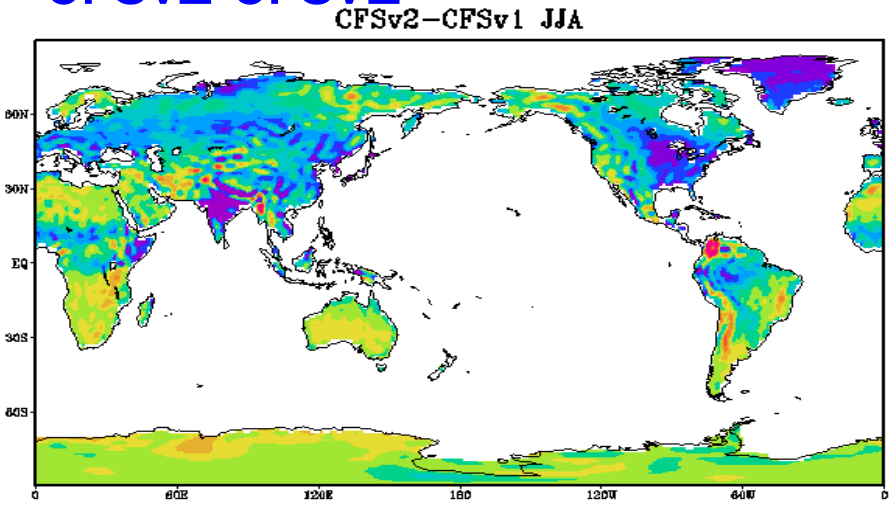


CFSv2

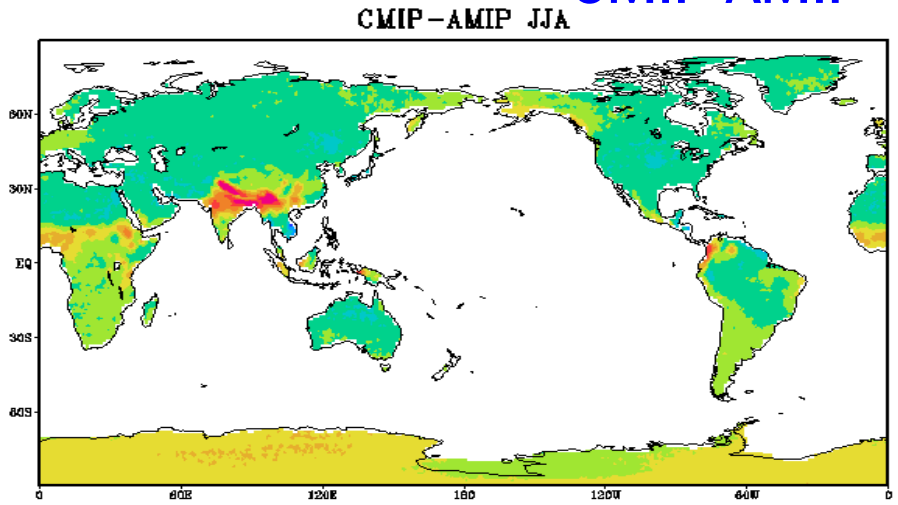


RDOWN DIFFERENCE

CFSv2-CFSv1



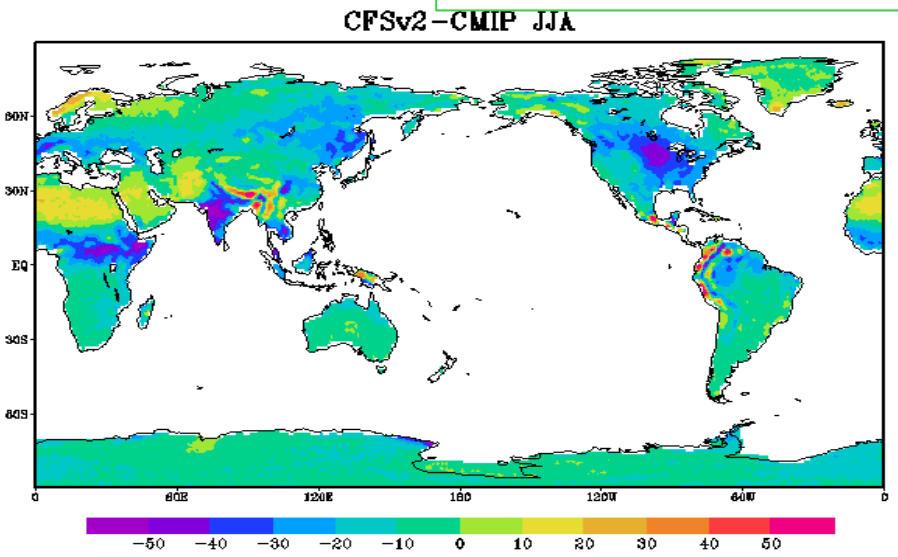
CMIP-AMIP



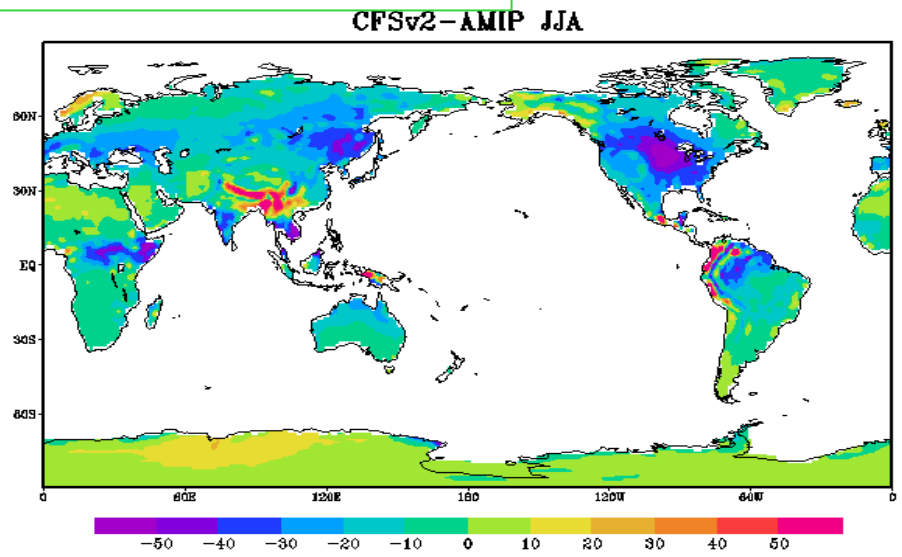
No surprise with CFSv2

The difference between CMIP and AMIP is small

CFSv2-CMIP

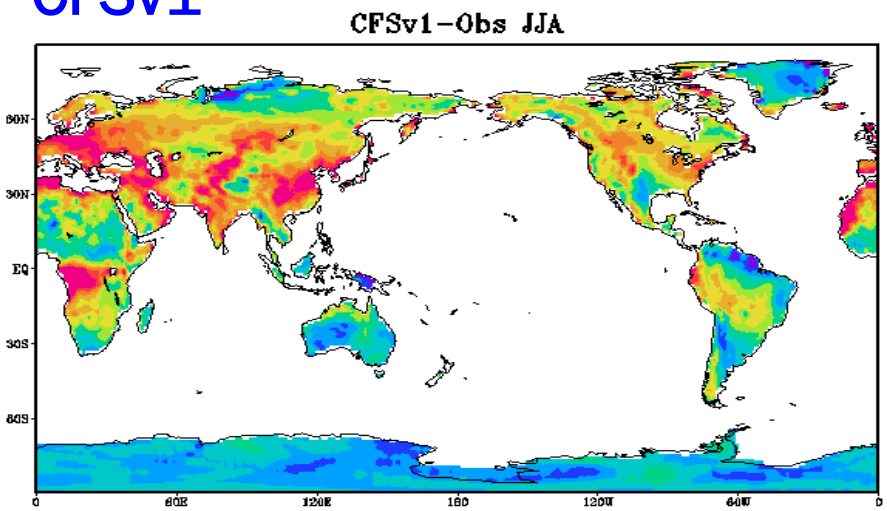


CFSv2-AMIP

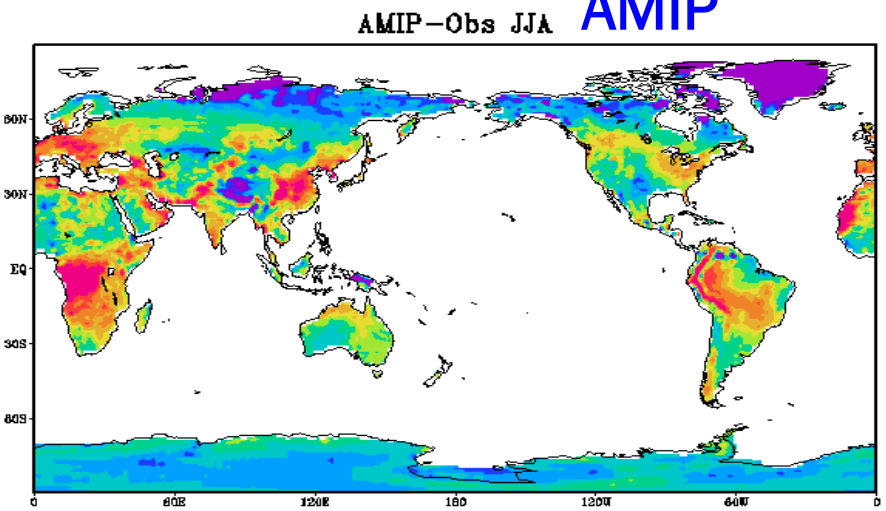


RNET - SRB

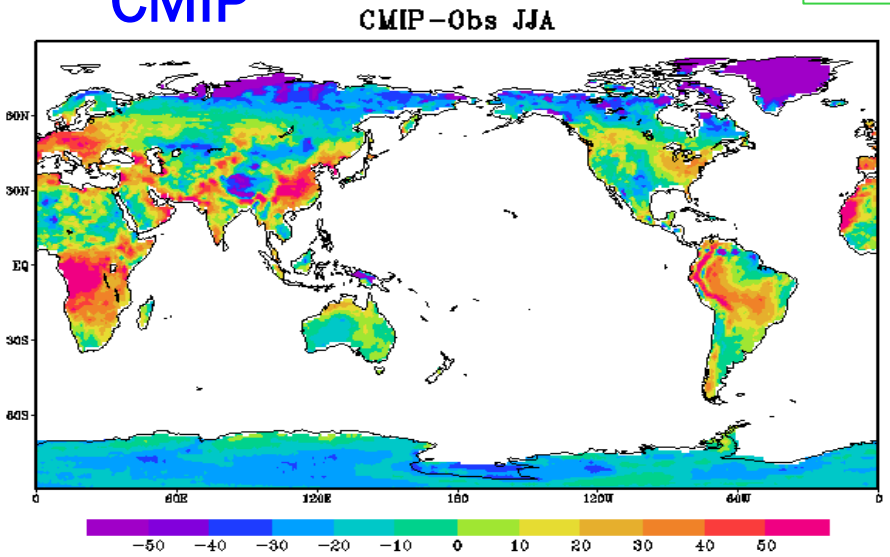
CFSv1



AMIP

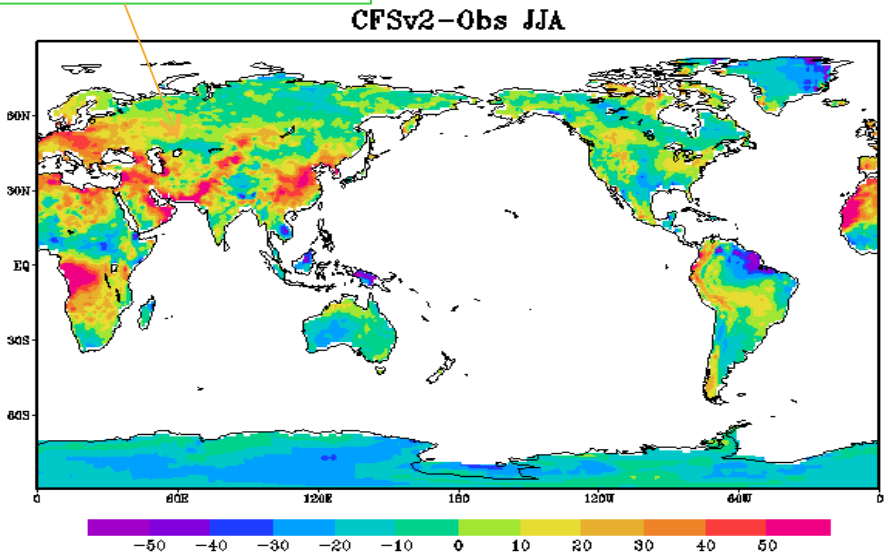


CMIP



Different from Rdown

CFSv2

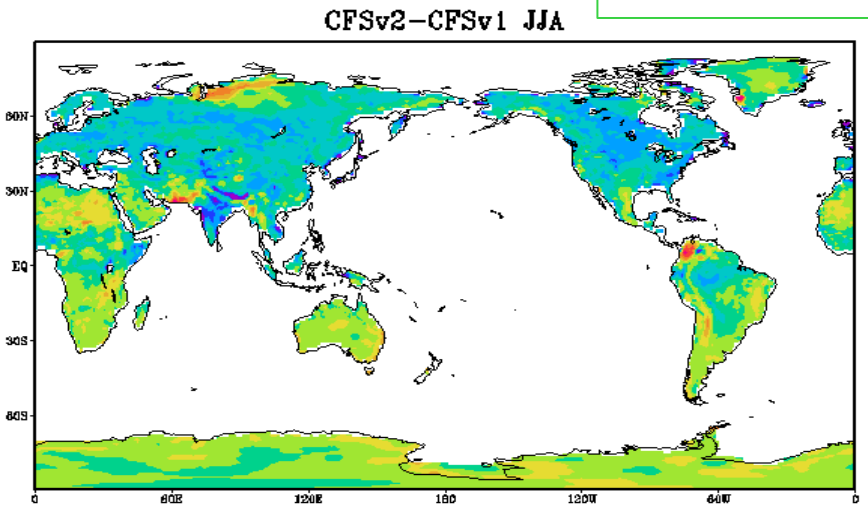


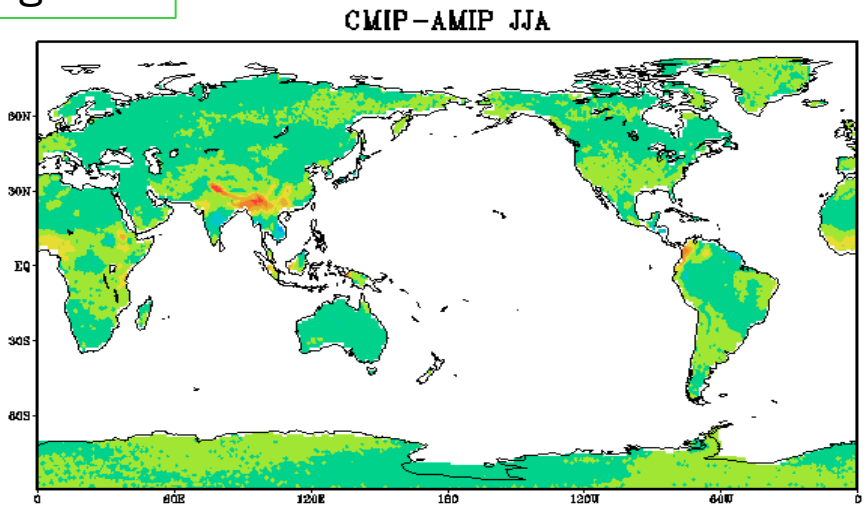
RNET DIFFERENCE

CFSv2-CFSv1

lower in mid-high lats

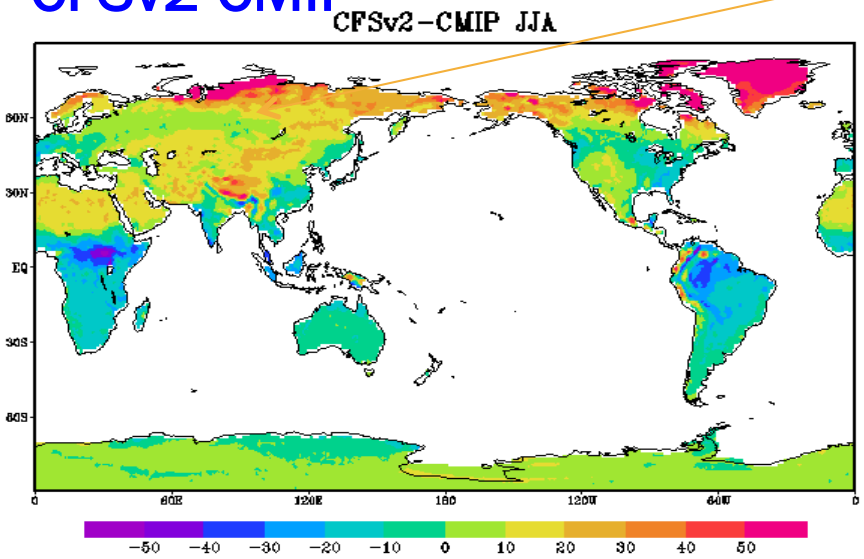
CMIP-AMIP



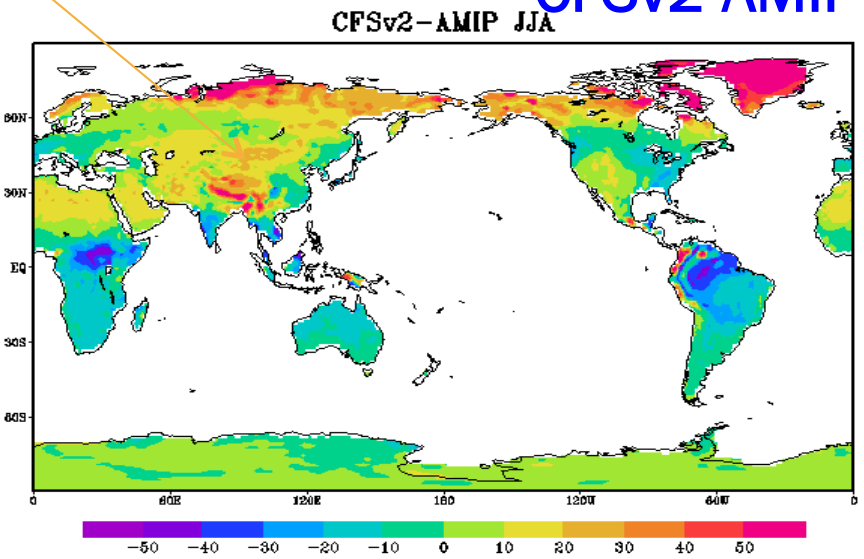


CFSv2 is higher even Rdown is lower, lower surface temperature.

CFSv2-CMIP



CFSv2-AMIP



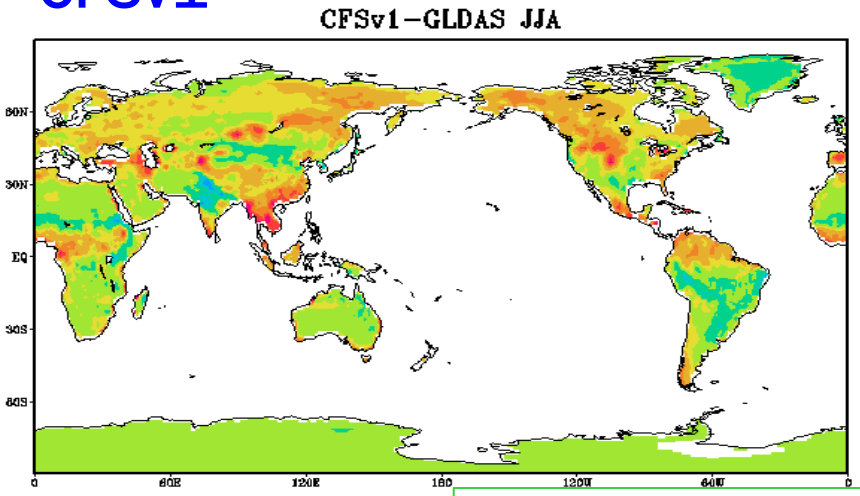
LATENT HEAT, SENSIBLE HEAT AND SOIL MOISTURE COMPARED TO

Global Land Data Assimilation System (GLDAS) using the same Noah land model

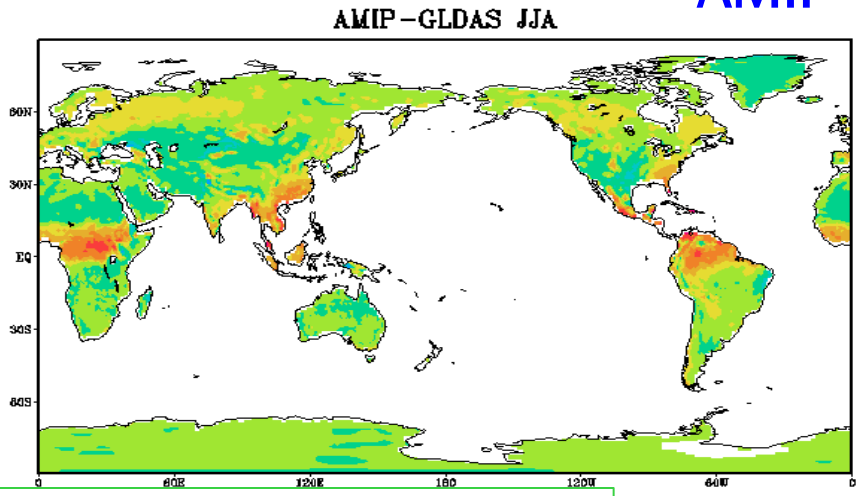
As a benchmark

LHTFL- GLDAS

CFSv1

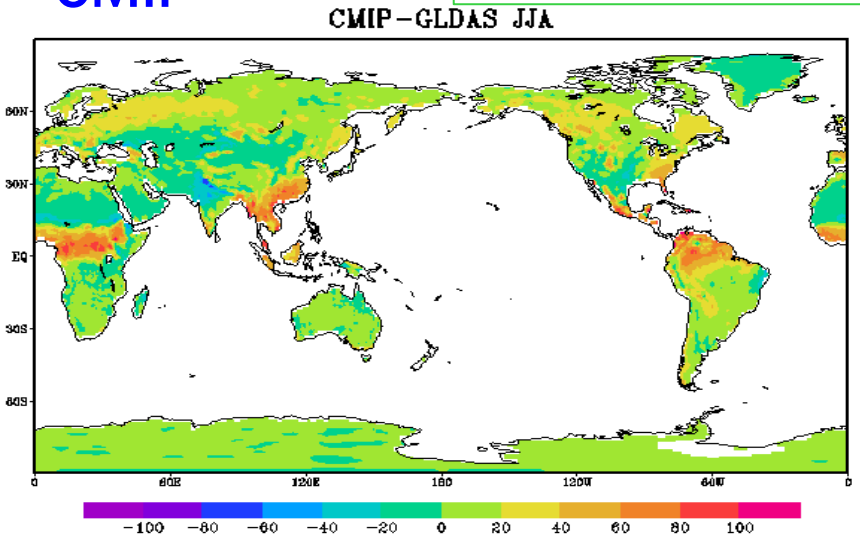


AMIP

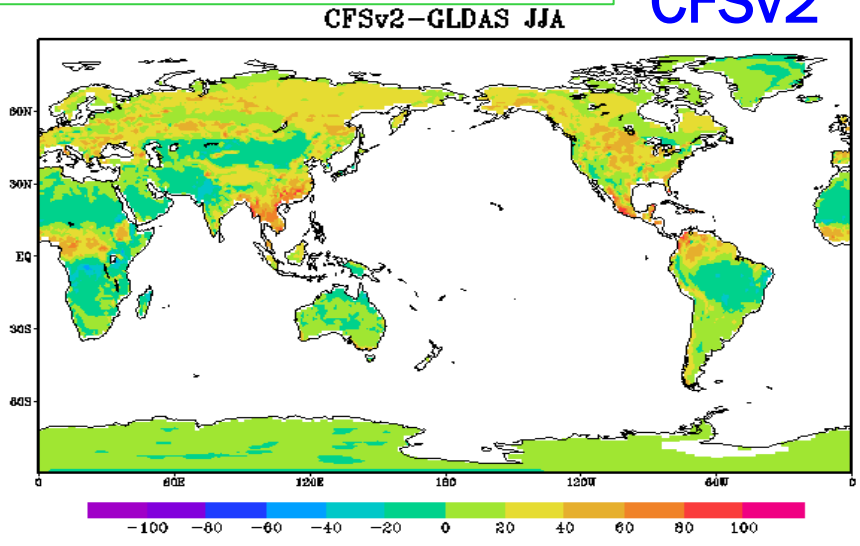


Consistent with the precipitation. CFSv1 highest, then CFSv2, AMIP, CMIP over N.H.

CMIP

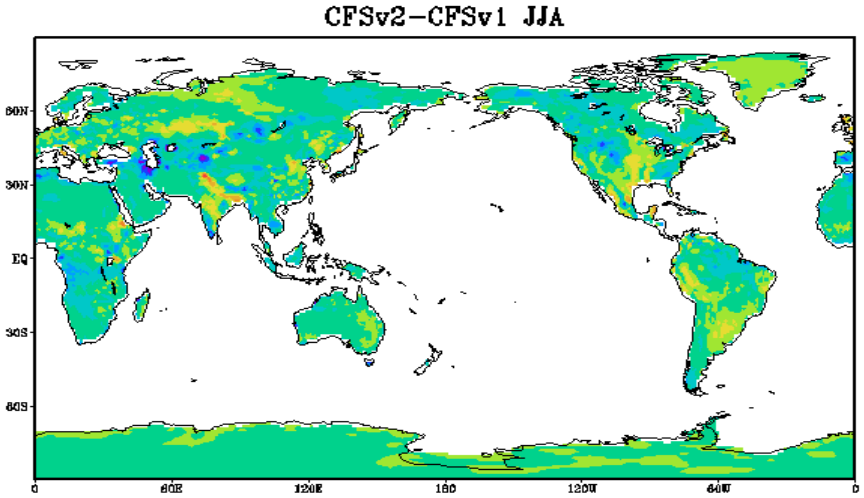


CFSv2

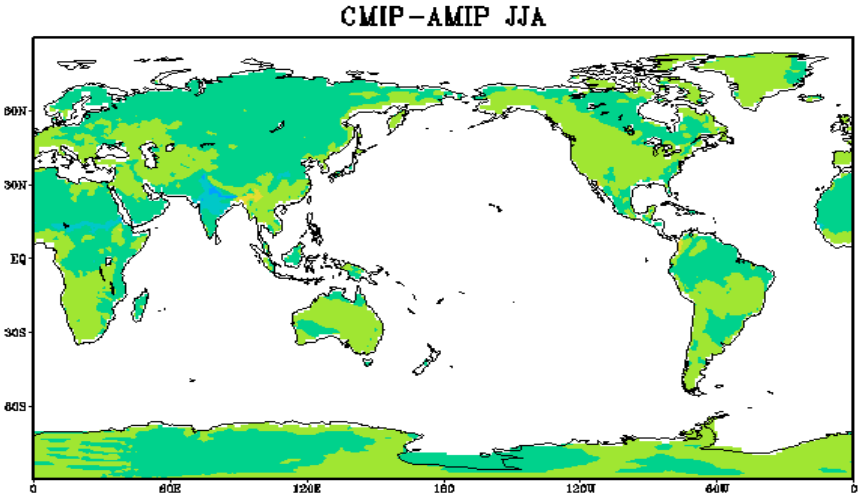


LHTFL DIFFERENCE

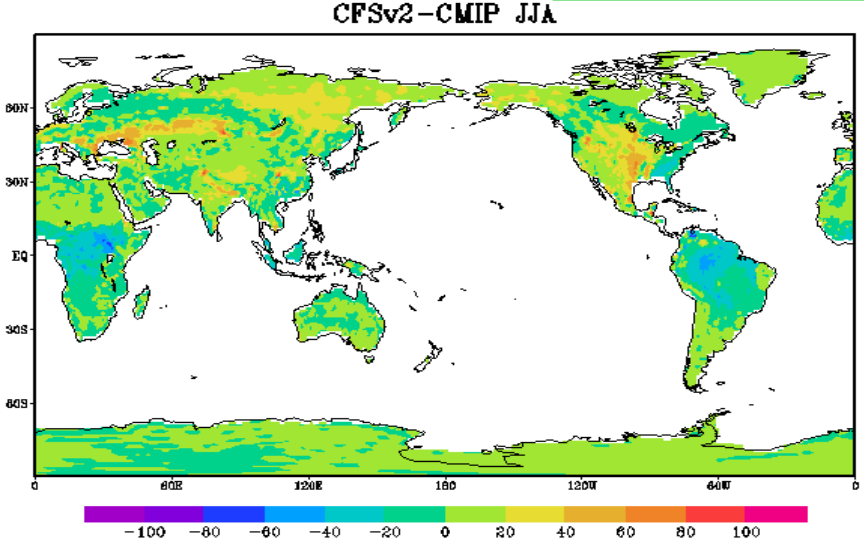
CFSv2-CFSv1



CMIP-AMIP

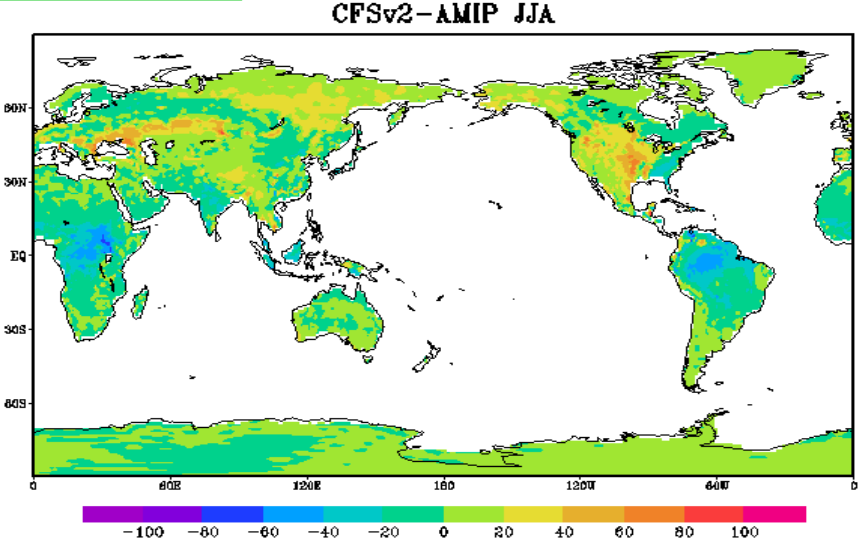


CFSv2-CMIP



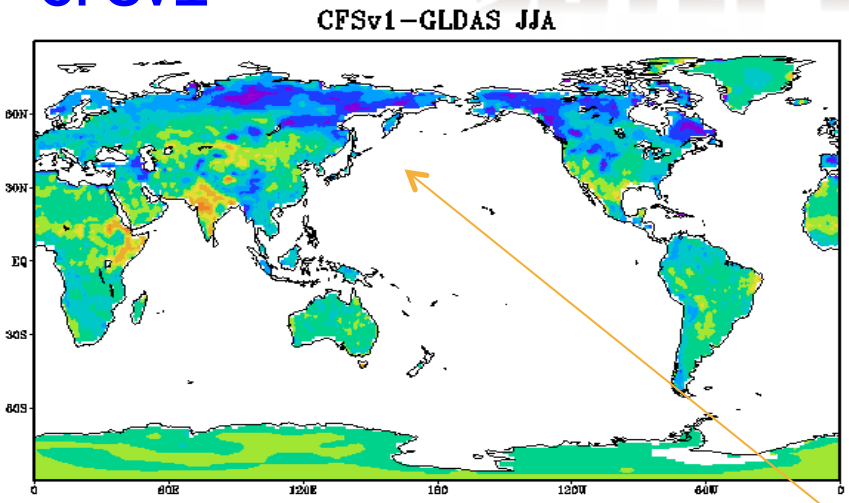
Higher in N.H., lower in S.H.

CFSv2-AMIP

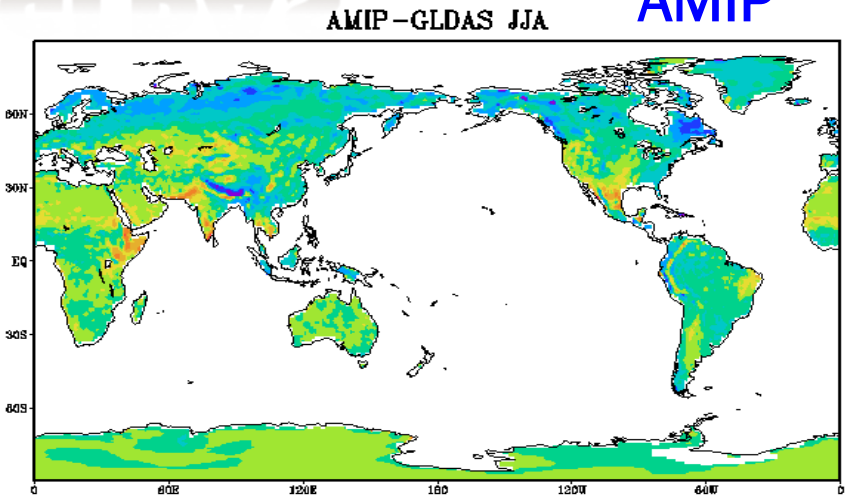


SHTFL - GLDAS

CFSv1

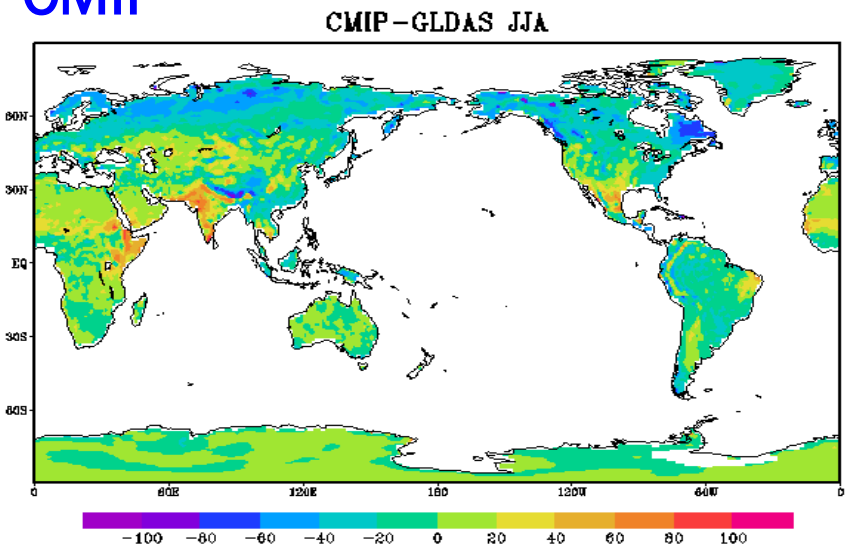


AMIP

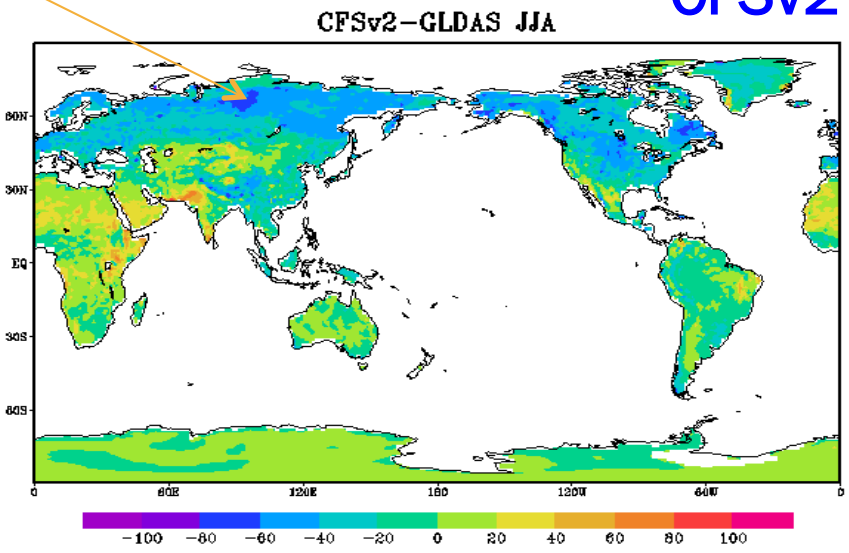


Like CFSv1, CFSv2 more energy goes to LHT.

CMIP



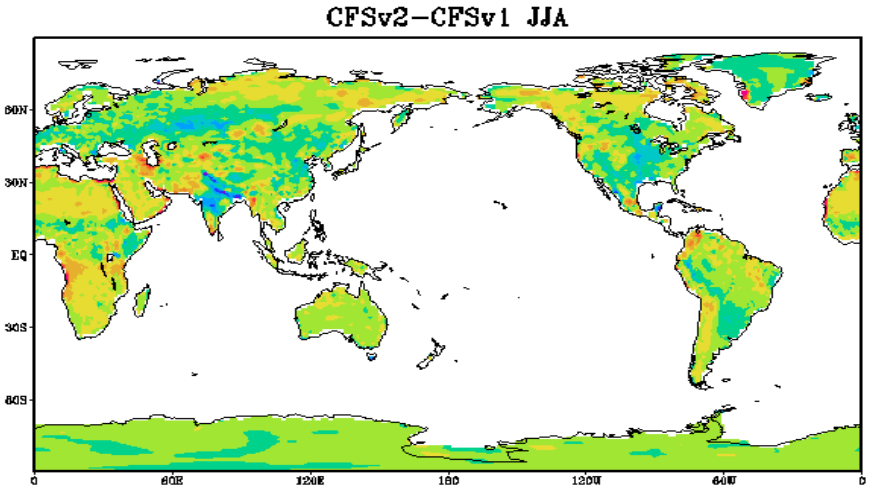
CFSv2



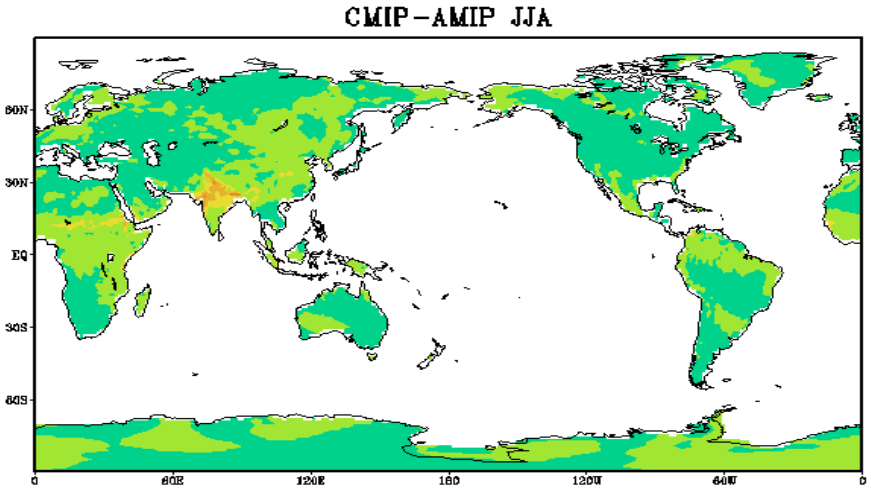
CFSv1 – due to higher precip, CFSv2, slightly higher precip and rnet compared CMIP and AMIP

SHTFL DIFFERENCE

CFSv2-CFSv1



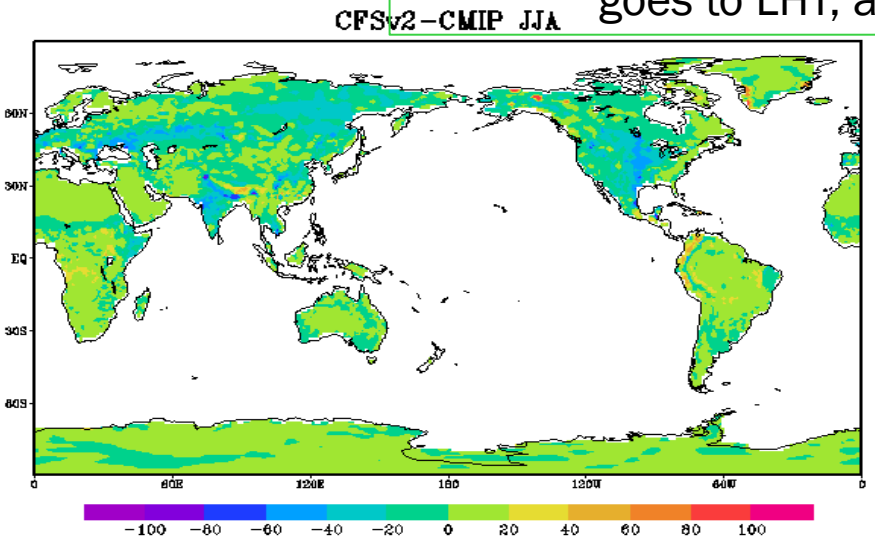
CMIP-AMIP

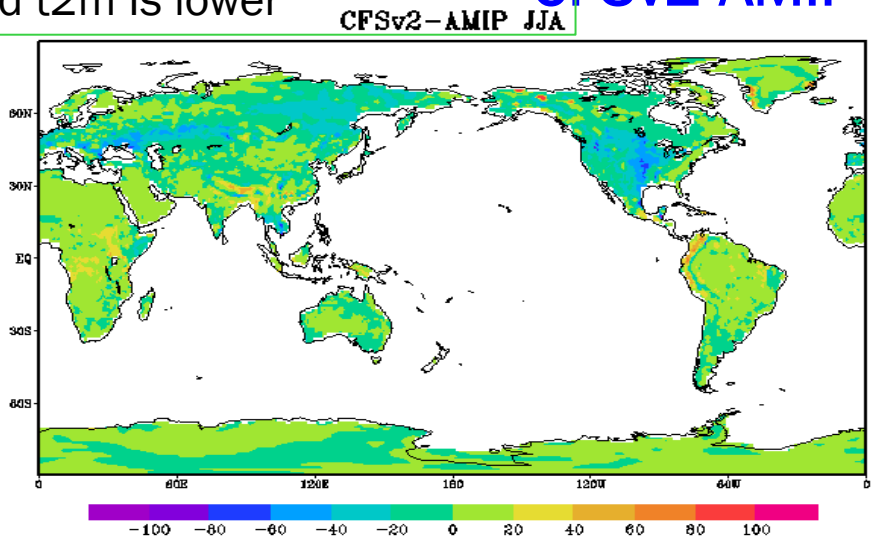


CFSv2-CMIP

CMIP, AMIP, CFSv2, CFSv1. Higher Rnet in CFSv2 goes to LHT, and t2m Is lower

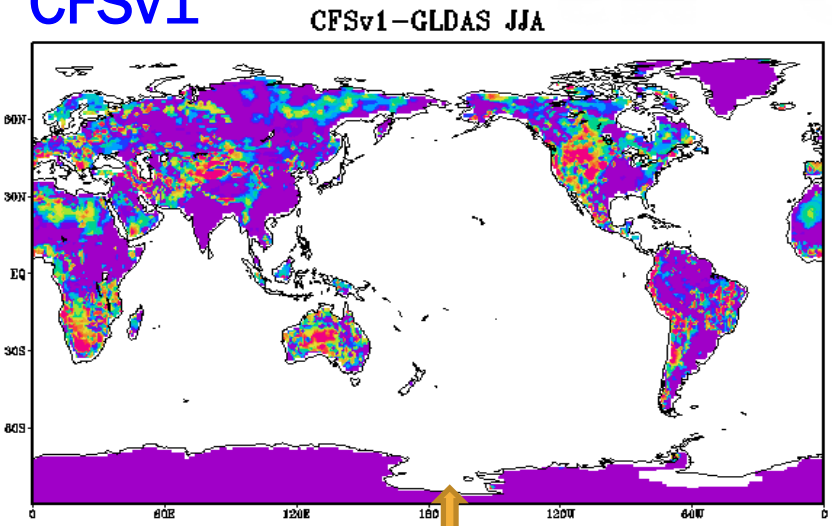
CFSv2-AMIP



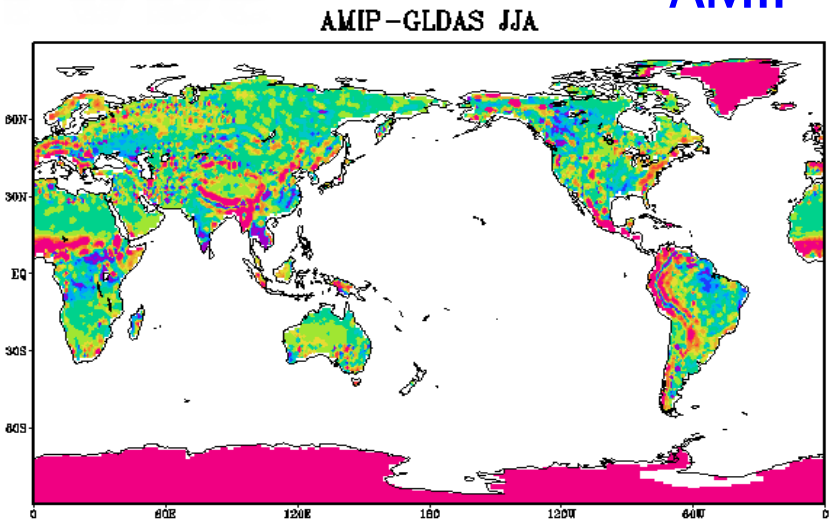


SM - GLADS

CFSv1



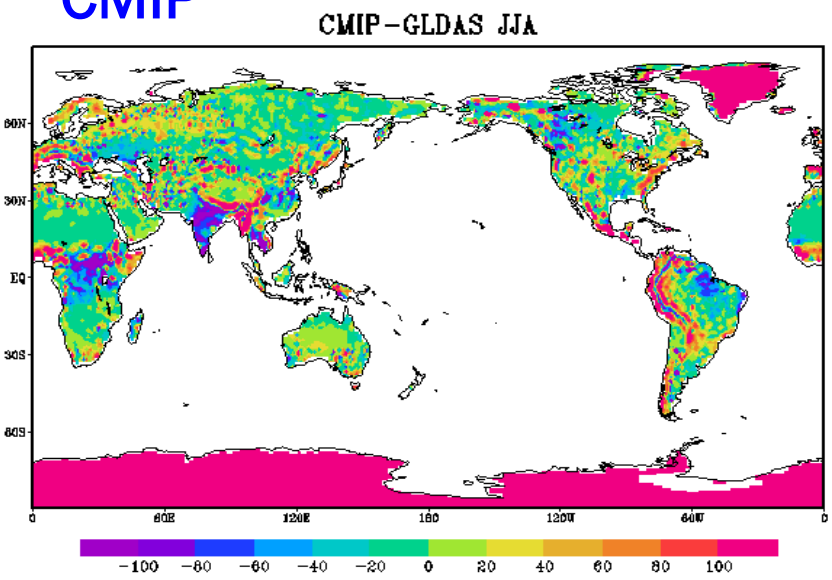
AMIP



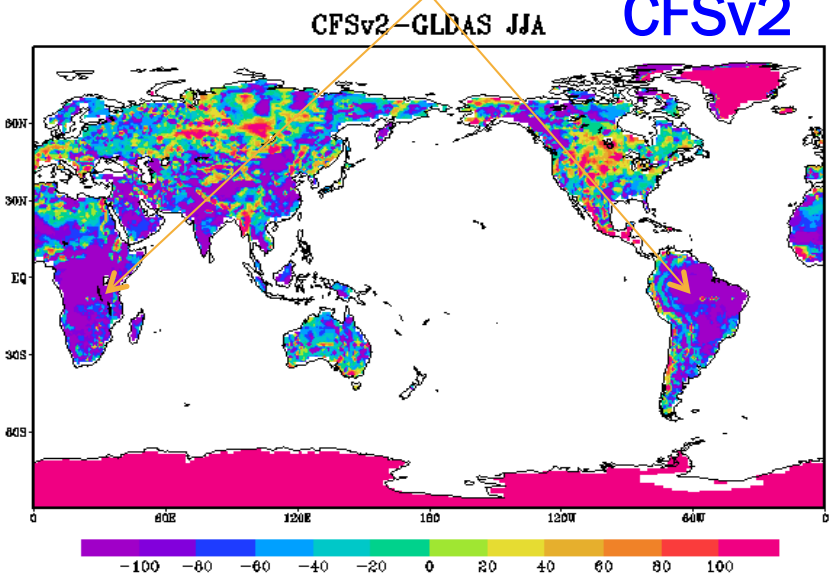
Expected. High LHT

CFSv2 SM is much lower, higher LHT

CMIP

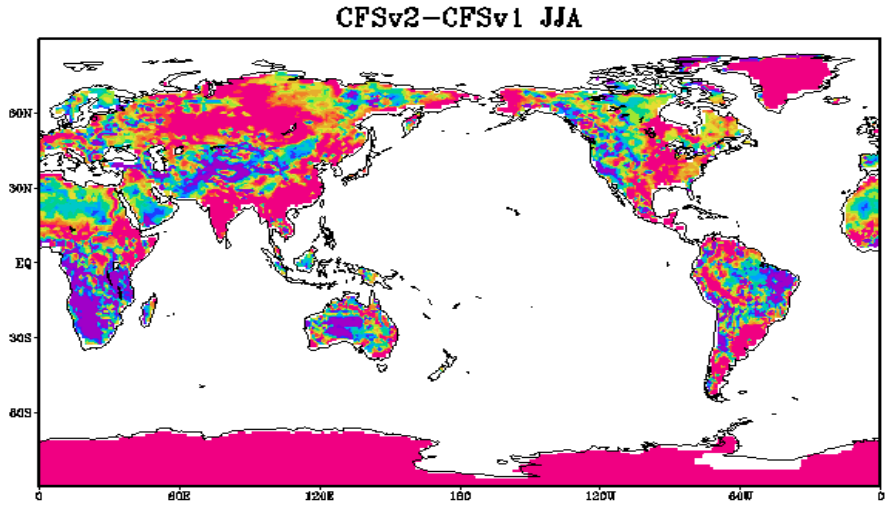


CFSv2

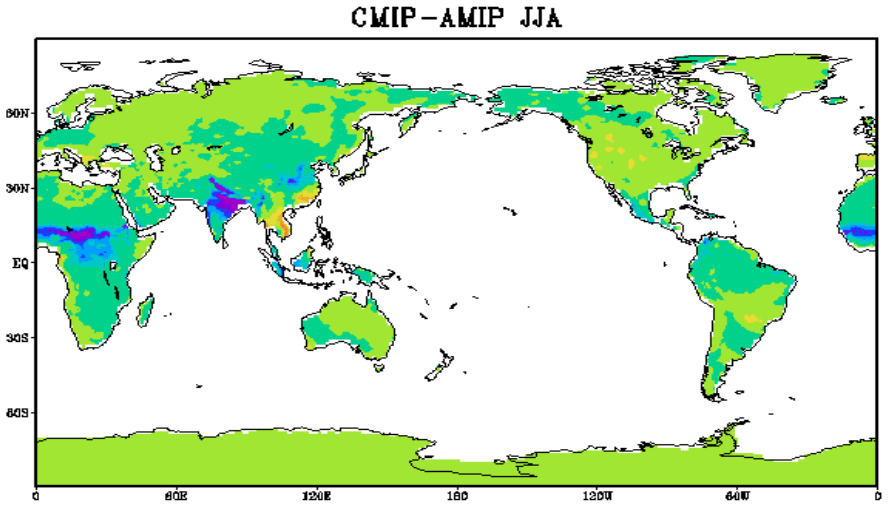


SM DIFFERENCE

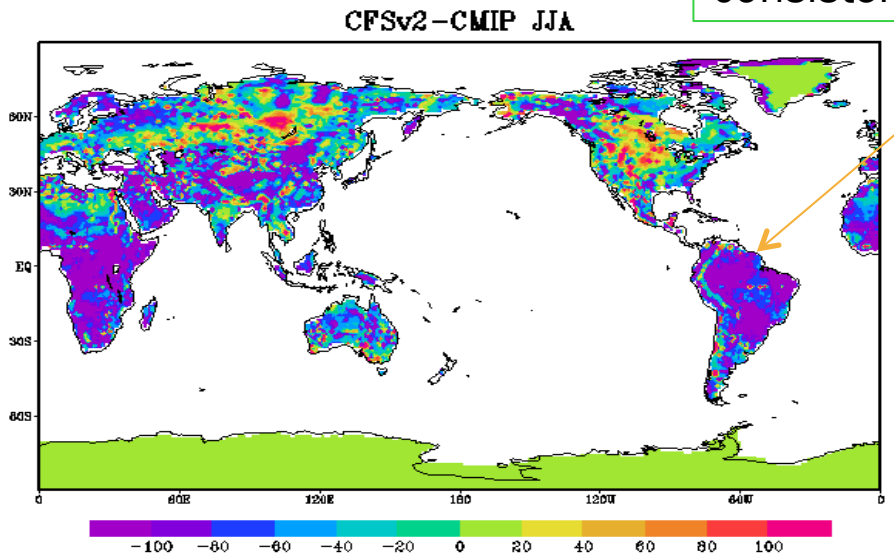
CFSv2-CFSv1



CMIP-AMIP

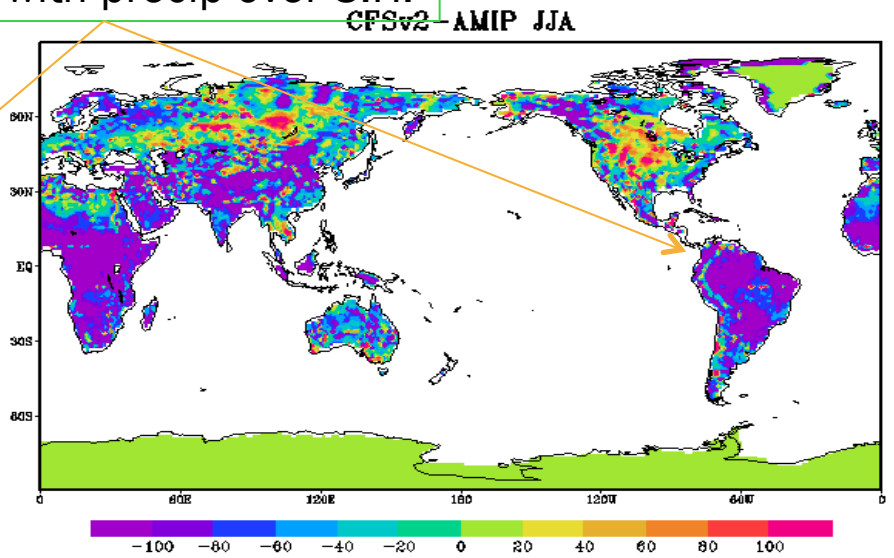


CFSv2-CMIP



CFSv2 SM is much lower consistent with precip over S.H.

CFSv2-AMIP



SUMMARY

1. Compared to CFSv1

CFSv2

- Better tropical SST
- Reduced high precipitation bias over the N.H.
- Slightly better precipitation skill over Europe-Asia.
- Better T2m and higher prediction skill Europe-Asia
- Better downward and net radiation
- Less latent heat and sensible heat
- Higher soil moisture and closer to GLDAS

2. Compared to CMIP

CFSv2

- sst performance varies depending on the Nino regions
- high precipitation bias over the N.H., low bias over the S.H.
- Lower precipitation skill over the S.A.
- Better T2m, but no clear advantage on the skill
- Less Rdown but higher Rnet over the N.H. and lower in the S.H.
- More latent heat and less sensible heat and soil moisture.

3. Compared to AMIP

CFSv2 Similar to CMIP

4. AMIP compared to CMIP

AMIP tends to perform worse, no big difference

SUMMARY (CONT'D)

- Overall, the CFSv2 has achieved a large improvement over the CFSv1 from the ocean, land and atmosphere upgrades.

- The atmosphere upgrade in CFSv2 seems to be more important, especially to radiation and resulted T2m prediction. Both CFSv2 and Op3t3 CFS has low sensitivity to ocean boundary.